Software Engineering

Books or notes are **not** allowed.
Write only on these sheets. **Concise** and **readable** answers please.

Surname, name, matricola ____

Exam management support system
Exam management for this course is made mostly on paper. The exam text is printed on paper, the student receives the paper sheet and writes on it. When the exam is completed she handles back the paper to the teacher who corrects it, writing on it with red ink.
The grades are decided by the teacher and published on a web site. Possibly the student checks her paper, and can reject the grade emailing the teacher.

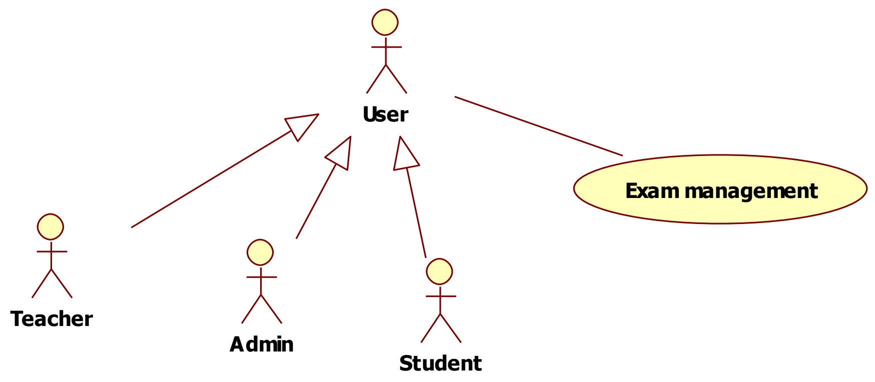
Many parts of this process can be improved as follows. Every student performs the exam using a PC; via the PC the student accesses a personal area (subject to authentication and authorization via account-name and password) where she finds the text of the exam. Using tools to be defined (aka an extension of google docs) the student completes her ‘paper’. When finished the paper is frozen and a pdf version of it is produced.
The teacher can correct each paper, using a pdf viewer, with the capability of writing corrections on the paper.
Points for each exercise are defined by the teacher, the overall grade is obtained.
The student can access, in her personal area, the paper, with corrections and grades.
Until a defined date the student can reject the grade, using an option on his personal area.
After this date is passed the teacher registers the grades. Registration of grades is made with the existing application. At this point do not consider any interaction with this application to register grades.

Consider this approach for several courses, and for each course several exams in different dates.
Consider this application as independent of the personal student area on polito.it used for administrative purposes. Also the credentials for this application (account-name password) are independent and possibly different from the ones on student.polito.it

In the following you should analyze and model a client server application to implement the exam management support system.

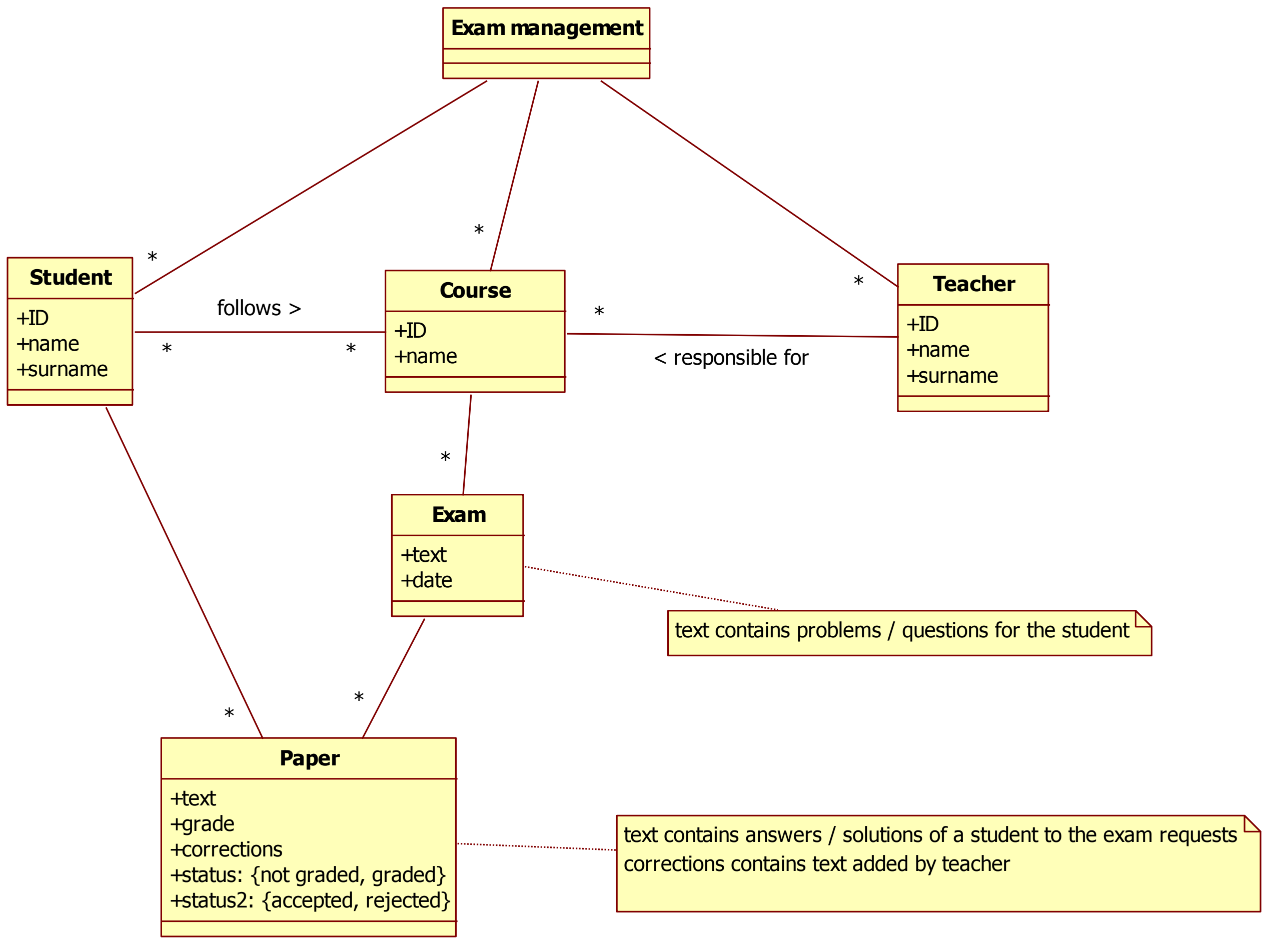
1 – a. Define the **context diagram** (including relevant interfaces)

Actor	Physical interface	Logical interface
Student	PC / smartphone	GUI
Teacher	PC / smartphone	GUI
Admin	PC	GUI



Authentication considered inside the application. Tools for students to edit the paper to be defined, could be internal to the application or external services. Application for registering grades considered outside, but without interaction with this application (as required from text)

1-b Define the **glossary** (key concepts and their relationships) (UML class diagram) for the application


Exam management
Student
+ID
+name
+surname
follows >
Course
+ID
+name
< responsible for
Teacher
+ID
+name
+surname
Exam
+text
+date
text contains problems / questions for the student
Paper
+text
+grade
+corrections
+status: {not graded, graded}
+status2: {accepted, rejected}
text contains answers / solutions of a student to the exam requests
corrections contains text added by teacher
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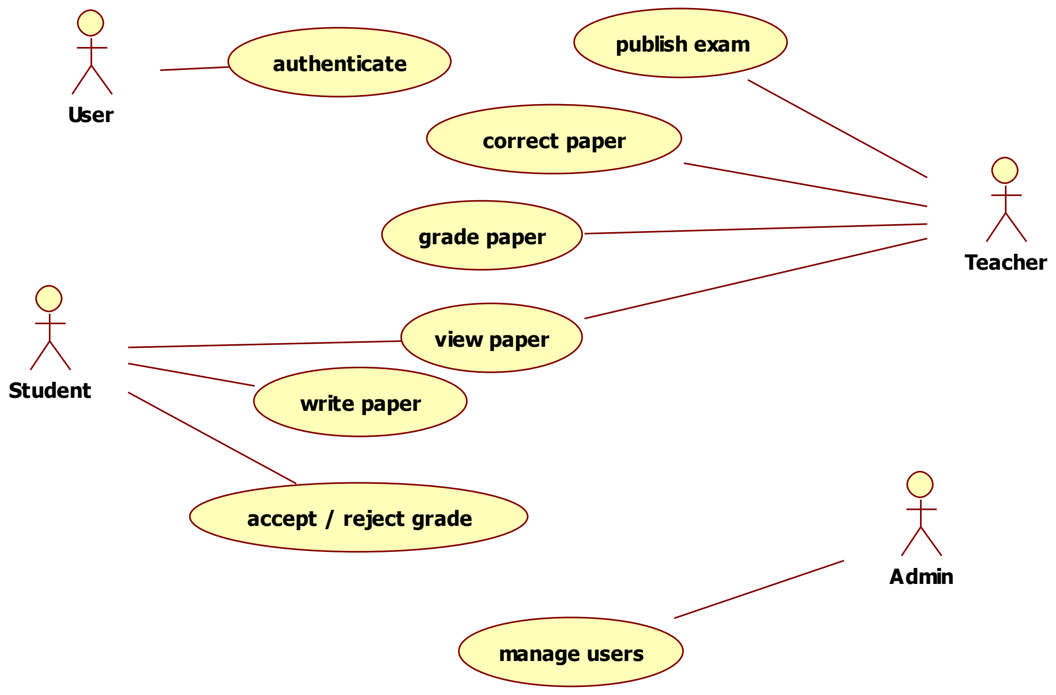
1-c Draw the Use Case Diagram for the application. For each Use Case give self-explainable long names, or a short textual description



From context diagram student, teacher, admin are also Users

1-D List the **NON functional requirements** that you deem important for the application

ID	Description
1	Privacy: student should see only his / her data
2	Usability: 99% of students should be able to use the application without training / instructions
3	Performance: all functions should have response time <0,5sec

1-e Describe below the scenario specific to a student who accesses his paper, corrected, and accepts the grade

Precondition: student S is authorized to access the application. Paper P about course C has been graded

Postcondition: grade accepted (available to be registered)

Step	Description
1	S selects course C
2	S selects paper P
3	S accepts grade
4	
5	

2 (7 points) -Define black box tests for the following function, using equivalence classes and boundary conditions.

The function *has_passed_exam* tells if a student has obtained a sufficient grade for the two exercises of an exam. Grades for each exercise, passed as parameters *exercise1* and *exercise2*, belong to the range [0, 15]. The student passes the exam if he obtains more than 7 points for each exercise, and if the sum of the two values is equal or greater than 18.

Students that have passed the intermediate lab do not need to perform the first exercise. The value of the parameter *lab* is equal to 1 if the student has passed the lab, otherwise it is equal to 0. If the student has passed the lab, the only condition for him/her to pass the exam is to have obtained more than 7 points for the second exercise.

The function returns 1 if the student passes the exam, 0 otherwise.

int has_passed_exam(int exercise1, int exercise2, int lab);

Examples:
has_passed_exam(8, 8, 0); 0
has_passed_exam(10, 10, 0): 1
has_passed_exam(14, 4, 0): 0
has_passed_exam(0, 5, 1): 0
has_passed_exam(0, 10, 1): 1

Exercise1	Exercise2	Lab	Exercise1+ Exercise2 >= 18	Valid/Invalid	TC
[minint, -1]	*	*	*	I	(-5, 5, 0): error B(**-1**, 5, 0): error
[16, maxint]	*	*	*	I	(20, 5, 0): error B(**16**, 5, 0): error
*	[minint, -1]	*	*	I	(5, -5, 0): error B(5, **-1**, 0): error
*	[16, maxint]	*	*	I	(5, 20, 0): error B(5, **16**, 0): error
*	*	[minint, -1]	*	I	(5, 5, -5): error B(5, 5, **-1**): error
*	*	[2, maxint]	*	I	(5, 5, 5): error B(5, 5, **2**): error
[0, 6]	[0, 6]	0	F *	V	(5, 5, 0): 0
“	“	1	F	V	(5, 5, 1): 0 B(**6**, 5, 1): 0
“	[7, 15]	0	F	V	(5, 8, 0): 0
“	“	“	T	V	(5, 13, 0): 0
“	“	1	F	V	(5, 8, 1): 1
“	“	“	T	V	(5, 13, 1): 1
[7, 15]	[0, 6]	0	F	V	(8, 5, 0): 0
“	“	“	T	V	(13, 5, 0): 0
“	“	1	F	V	(8, 5, 1): 0
“	“	“	T	V	(13, 5, 1): 0
“	[7, 15]	0	F	V	(8, 8, 0): 0 B(8, **7**, 0): 0
“	“	“	T	V	(13, 13, 0): 1 B(**7**, 11, 0): 1
“	“	1	F	V	(8, 8, 1): 1
“	“	“	T	V	(13, 13, 1): 1 B(**15, 15**, 1): 1

*condition exercise1 + exercise2 >= cannot be false for both variable belonging to eq. class [0, 6]
NB: it could be possible to use * (or don’t care) for Exercise1 if Lab value was equal to 1, since the description of the function does not specify that it has to be mandatorily 0.

3 (7 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, path coverage. For the test cases, **write only the input value**.

Write control flow graph here

```
1   int grade(int answers[5][4], int solutions[5][4]) {
2
3     int grade = 0;
4     int i, j;
5
6        for (i = 0; i < 5; i++) {
7            for (j = 0; j < 4; j++) {
8                 if (answers[i][j] == solutions[i][j] && solutions[i][j] == 1)
9                       grade+=3;
10              else if (answers[i][j] != solutions[i][j] && solutions[i][j] == 0)
11                grade-=1;
12           }
13        }
14    if (grade < 0)
15        return 0;
16    else
17        return grade;
18  }
```

Coverage type	Number of test cases needed to obtain 100% coverage	Coverage obtained with test cases defined (%)	Test cases defined
Node	2	100%	T1, T2
Edge	2	100%	T1, T2
Multiple condition line 8	In theory 4, 1 with different iterations of the inner loop.	100%	T1
Loop line 6	Not feasible: loop is not controlled by input values.	33% (only multiple iteration)	T1 or T2
Path	3^(4*5) * 2	More than six million test cases to obtain full path coverage.	

To avoid writing all the values for the input matrices (20 values) only the first rows of answers and solutions are written, and it is supposed that all other values are equal to 0.

T1({{1, 1, 0, 0, 0}, ….}, {{1, 0, 1, 0, 0}, ….}) -> grade = 1;
T2({{1, 1, 1, 1, 1}, ….}, {{0, 0, 0, 0, 0}, ….}) -> grade = 0 (grade less than 0 before line 14)

4 (1 points) – You have to start a software project. What are the factors to consider in selecting a suitable software process?

Criticality (safety critical, mission critical, other), size (correlates to number of developers needed), domain, maintenance vs new development

5 (1 point) – What is the difference between ‘correctness’ and ‘reliability’?

Correctness: a program produces the requested output for every input in the input space

Reliability: probability of providing the requested output over a period of time

Correctness is equal to reliability=100% over an infinite period of time
Normally defects are contained by a program, so reliability is <100% over a finite period of time

6 (1 point) – Describe how versioning is implemented in Subversion.

All Configuration items in a configuration inherit version number from the configuration
Configuration version number increments by 1 (1,2,3,4,…)

7 (1 point) – Describe briefly the SCRUM approach

See slides

8 (1 point) – Describe the ‘repository’ architectural style, and when it can be used

See slides
Remark that the answer is NOT about describing repositories for configuration management (svn, git etc)