Software Engineering

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

Surname, name, matricola ____

Health portal
The Piedmont region is the public health provider for citizens living in the region. To improve the health services the region has developed a web portal, accessible via PC and Smartphone, to deliver a number of services both to citizens, analysis labs, general practitioners.
A citizen, to access any medical service from the public system, must first select a general practitioner. A general practitioner issues analysis requests, medicine requests, and so on. A citizen selects an analysis lab to perform an analysis, as requested by the general practitioner.

To access any service an end user has to authenticate first. Authentication is performed via SPID, the authentication service for Italy. In principle, every Italian citizen should obtain a digital identity provided by SPID. This identity is used to access any service offered by the public administration. The service and the SPID interact to provide the authentication. A citizen accesses a service, the service redirects to the SPID, the citizen sends to the SPID service its social security number and password, receives an OTP (one time password) via SMS on her cellphone, introduces the OTP. If all is correct the user is authenticated and sent back to the service for a one session interaction. In this case the service is health portal for a session.

The portal can be used by a citizen to

- Upload health documents. A health document in pdf format can be of several types (ex lab analysis result, lab analysis request, medical report etc), has an issue date and a doctor who signs it.
- Browse or search health documents
- Open, read, download a health document
- Browse through available general practitioners, select a general practitioner
- Browse through available lab analysis, send a lab analysis request to the selected lab

In its turn a general practitioner can use the portal to

- Browse the list of citizens she takes care of
- Select a citizen
- Browse, select, read, download a health document belonging to the citizen
- Upload a lab analysis request for the citizen

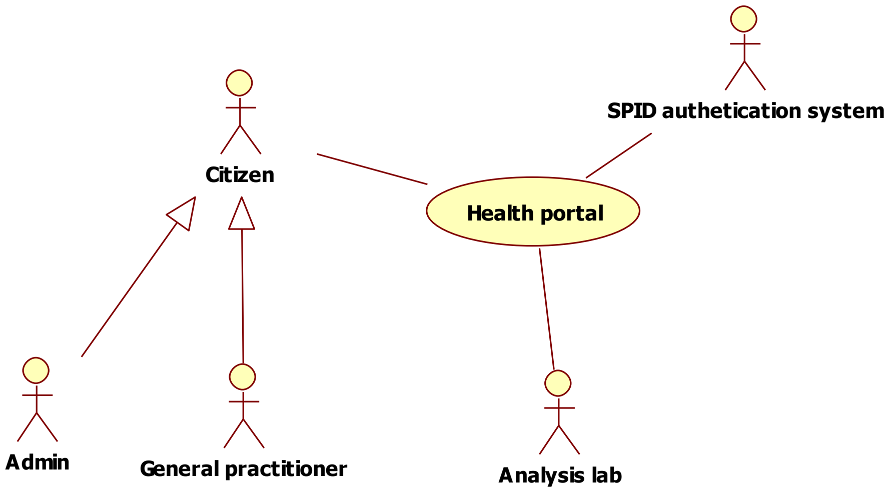
Finally, an analysis lab can use the portal to send the resulting lab analysis result to the concerned citizen

In the following you should analyze and model a client server application to implement the web portal.

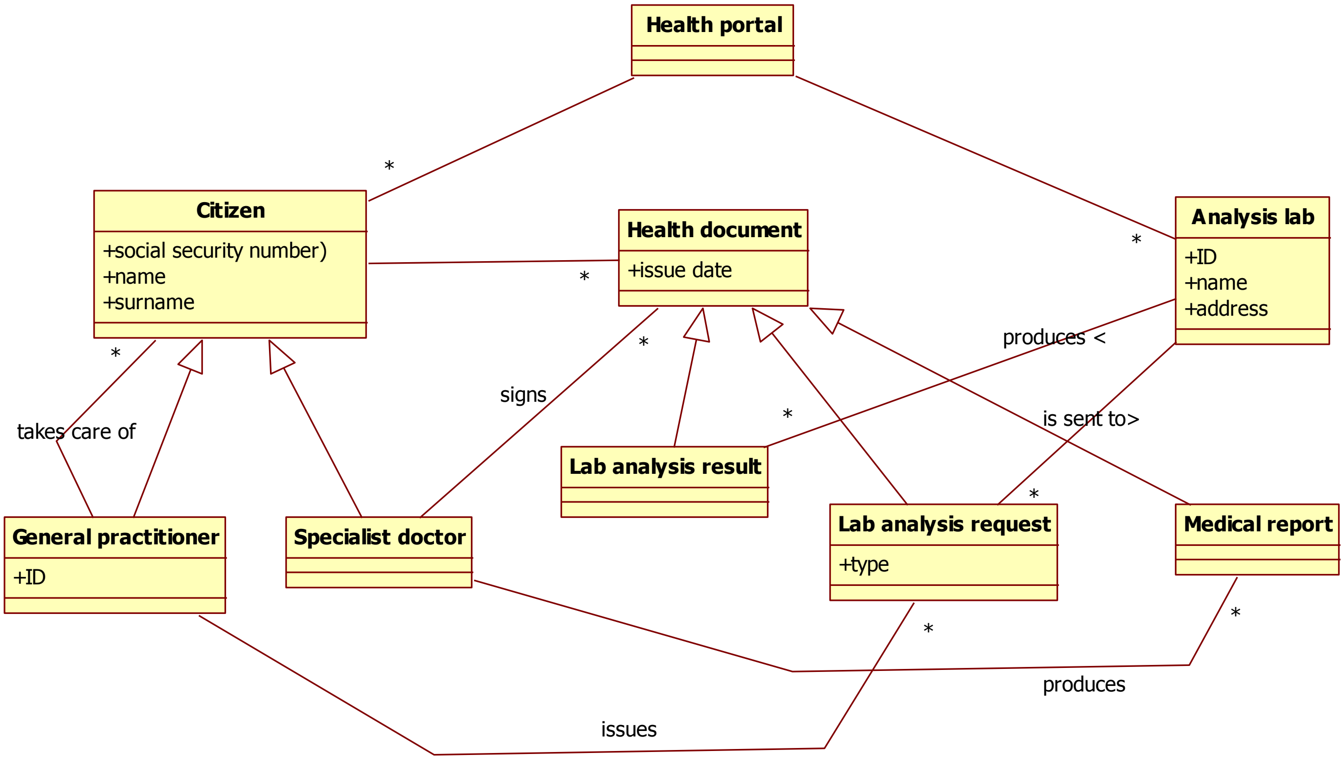
1 – a. Define the **interfaces** (table below) and **context diagram**

Actor	Physical interface	Logical interface
Citizen	PC / smartphone	GUI
Analysis Lab	PC	GUI
SPID	Internet connection	Web services with specific authentication protocol

The SPID is external to the health portal, but it interacts with it to perform the authentication, so it should be represented as an actor. See also the UCD in 1-c



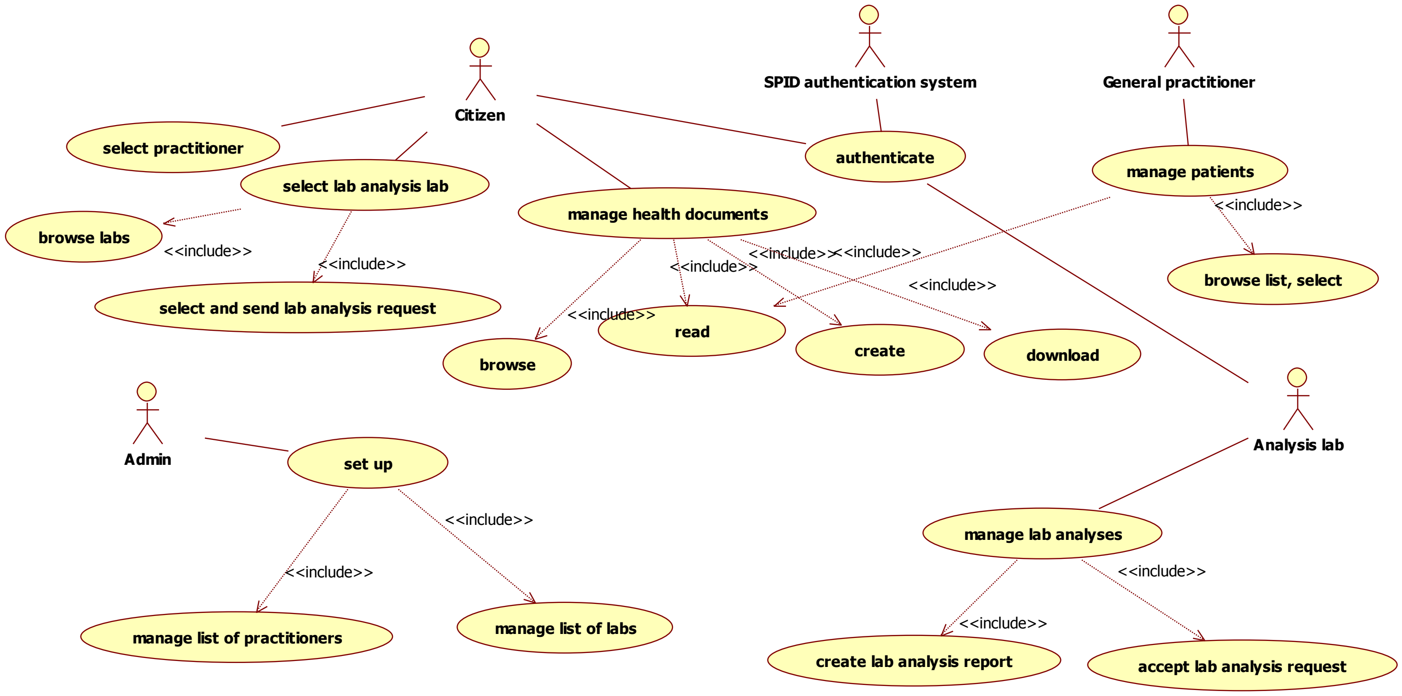
1-b Define the **glossary** (key concepts and their relationships) (UML class diagram) for the application



It is important to define subclasses for Health Document, because they are attached to different relationships

1-c Draw the Use Case Diagram for the application. For each Use Case give a short description in the table

Use Case ID	Description



A certain UC shared by many actors (ex authenticate, read health document) must NOT be repeated
The UC authenticate does not perform the whole authentication, but manages the interaction with SPID, that in fact implements the authentication

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

ID	Description
1	Privacy.: health documents of a citizen should be seen only by the citizen, and, under authorization of the citizen, by her practitioner
2	Efficiency, response time of all functions <,5 sec
3	Usability, all user should be able to use the system in <30min without training
4	Interoperability: Web portal should be accessible to notebooks, desktops, smartphones

1-e Describe below the scenario specific to a citizen who selects a general practitioner

Precondition: citizen C has a SPID account. C is authorized to access the web portal for one session

Postcondition: citizen C is associated to general practitioner GP

Step	Description
1	C browses list of general practitioners
2	C selects one general practitioner, GP
3	C asks to be associated to GP
4	Web portal accepts and communicates to C selection is accepted
5	

2 (7 points) - Define black box tests for the following function, using equivalence classes and boundary conditions. You can prune the solution space if the combinations of the possible equivalence classes are too many.

The Piedmont region issues benefits for a free sanitary ticket to certain classes of people. To benefit of the privilege, a person must satisfy a set of conditions. A person is eligible if he/she is younger than 6 years old, or older than 65 years old, and his family income is less than €36151.98. An unemployed person of any age is eligible for the benefit if he/she has a family income lower than €8263.57.

The function isEligibleForTicket receives as parameter age (the age of the person), family_income (the total income of the person's family), isEmployed (an integer parameter which is 0 if the person is unemployed, and 1 if the person is employed). It gives as output 1 if the person is eligible for the free sanitary ticket, 0 otherwise.

int isEligibleForTicket(int age, double family_income, int isEmployed);

Examples:

isEligibleForTicket(5, 21000, 0) -> 1
isEligibleForTicket(75, 40000, 0) -> 0
isEligibleForTicket(35, 7000, 1) -> 0
isEligibleForTicket(35, 7000, 0) -> 1

Age	Income	isEmployed	Valid / Invalid	TC
[minint, -1]	*	*	I	(-10, 2000, 1) error
*	[mindouble, 0)	*	I	(20, -2000, 1) error
*	*	[minint, -1]	I	(20, 2000, -2) error
*	*	[2, maxint]	I	(20, 2000, 4) error
[0, 5]	[0, 8263.57)	{0}	V	(3, 2000, 0) : 1 B(**0**, 2000, 0): 1 B(**5**, 2000, 0): 1
“	“	{1}	V	(3, 2000, 1): 1
“	[8263.57, 36151.98)	{0}	V	(3, 15000, 0): 1 B(3, **36151.97999**, 0): 1
“	“	{1}	V	(3, 15000, 1): 1
“	[36151.98, maxdouble)	{0}	V	(3, 50000, 0); 0 B(3, **36151.98001**, 0): 0
“	“	{1}	V	(3, 50000, 1); 0
[6, 65]	[0, 8263.57)	{0}	V	(20, 2000, 0): 1 B(**6**, 2000, 0): 0 B(**65**, 2000, 0): 0 B(20, **8263.56999**, 0): 1
“	“	{1}	V	(20, 2000, 2): 0
“	[8263.57, 36151.98)	{0}	V	(20, 15000, 0): 0 B(20, **8263.57001**, 0): 0
“	“	{1}	V	(20, 15000, 1): 0
	[36151.98, maxdouble)	{0}	V	(20, 50000, 0): 0
	“	{1}	V	(20, 50000, 1): 0
[66, maxint)	[0, 8263.57)	{0}	V	(80, 2000, 0): 1 B(**66**, 2000, 0): 1
“	“	{1}	V	(80, 2000, 1): 1
“	[8263.57, 36151.98)	{0}	V	(80, 15000, 0): 1
“	“	{1}	V	(80, 15000, 1): 1
“	[36151.98, maxdouble)	{0}	V	(80, 50000, 0): 0
“	“	{1}	V	(80, 50000, 1): 1

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 isUnemployedEligible(double family_income, int is_married, int n_children, int* children_age) {
2
3       double minimum = 8263.31;
4       int error = 0;
5       int i;
6
7       if (is_married == 1)
8               minimum += 3099.05;
9
10      for (i = 0; i < n_children; i++) {
11              if (children_age[i] < 0 || children_age[i] > 100)
12                      error = 1;
13              else if (children_age[i] < 18)
14                      minimum += 516.46;
15      }
16
17      if (error == 1)
18              return -1;
19      else if (family_income < minimum)
20              return 1;
21      else
22              return 0;
23
24      }
```

Coverage type	Number of test cases needed to obtain 100% coverage	Coverage obtained with test cases defined (%)	Test cases defined
Node	3	100%	T1, T2, T3
Edge	3	100%	T1, T2, T3
Multiple condition line 11	3 in theory (1 in this case with loop)	¾ (75%)	T4
Loop line 10	3	100%	T1, T2, T3
Path	2*3*3^(n_children)		

Write test case ID (T1, T2 ..) in the rightmost column, and test cases here

T1(10000, 1, 1, { -5 });
T2(30000, 0, 2, { 15, 21 });
T3(2000, 1, 0, {});
T4(2000, 2, 3, { -2, 15, 21 });

4 (1 points) – What are the typical states of a Change Request in a maintenance process?

See slides

5 (1 point) – What is the basic principle of the Visual approach to GUI testing? What is different with respect to layout-based scripted GUI testing?

Visual approach: graphic components (buttons, menus etc) are recognized via image recognition
Layout approach: graphic components are identified retrieving their ID (used by the graphic library) or by specific unique properties.

6 (1 point) -- Provide an example of a static analysis rule from MISRA-C

See slides

7 (1 point) – Describe briefly the pair programming technique from XP

See slides

8 (1 point) – Describe the 'pipeline' architectural style, and when it can be used

Many modules are connected in a sequence. Each module is independent of others. Data from one module flow to the next one. Data is the only communication means to a module.
Ex: compiler linker. Ex: unix shell