Software Engineering

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

Surname, name, matricola ____

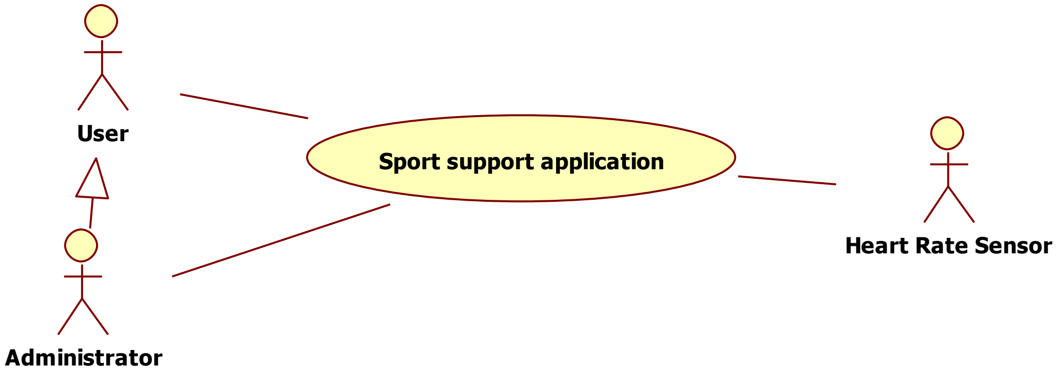
Sport support application
A sport support application allows a user to log her sport activities, both to keep track of them, and analyze performances, and share with friends. They run on smartphones equipped by GPS, while the analysis of performance part can be done both on the smartphone or through a browser on a web site.
The basic unit managed by the application is the training. A training has a start time, a stop time, an attached sport (cycling, jogging, walking, skiing etc). It also has a geographical route, that is collected through the GPS. The training can be split in parts. So a typical scenario is the following: the user starts a new training, and when done he stops it. Or the user starts a new training, stops a part and starts another part, one or more times, then stops the training. (Typical usage of parts is to measure laps when running on a circular track).
In some cases the user can take pictures during the training. The picture is geo-referenced and also attached to the training.
If the user has a heart rate monitor (a sensor put on the chest, and linked via Bluetooth to the smartphone) the heart rate log is also attached to the training
On the analysis side, the user can: see a list of all her trainings, select one, see charts (speed chart, altitude chart, heart rate chart), see metrics (average speed, max speed, per training and per part, etc), see the route followed on a map, see pictures taken, on the same map.
On the social side, a user can define a list of friends, and share with them one or more trainings.

In the following you should analyze and model the sport support application.

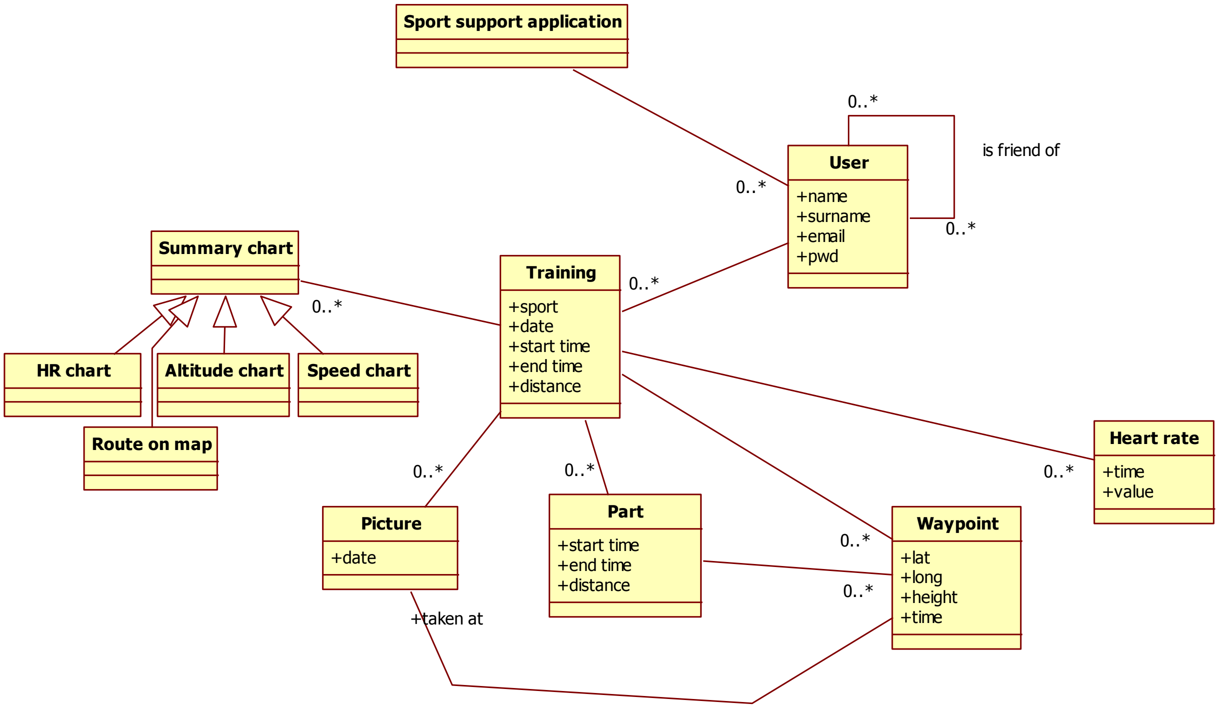
1 (15 points) – a. Define the context diagram (including relevant interfaces)

Actor	Physical interface	Logical interface
User	PC / smartphone	GUI for user function (see list of functional requirements)
Administrator	PC	GUI for admin functions (see list of functional requirements)
Heart rate sensor	Bluetooth	Read heart rate

GPS receiver and camera are other possible actors. Since they are typically integrated in the smartphone they could be omitted (same as screen, keyboard). Admin is needed, because the app has a server part, implied by the fact that it can be accessed via PC and / or smartphone. Friends in the social network are just users (not another actor but a role played by a user).



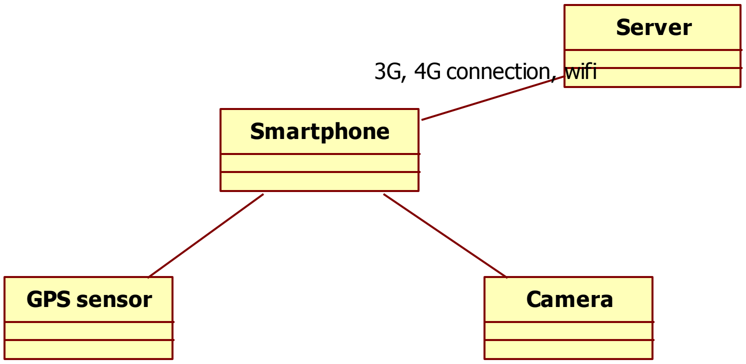
Define the key concepts and entities and their relationships (UML class diagram) for the application



Classes waypoint and heart rate are needed, no ‘arrays’ are acceptable in a conceptual diagram.

Classes for Physical objects (GPS sensor, Smartphone, HR sensor) are not wrong here, but in fact belong to the system design diagram. I report it below (was not requested).

System design



HR sensor does not appear in the system design because it is considered outside the system (as from context diagram). Another option is to consider it inside the system. In this case it would not be an actor in the context diagram but a class in the system design.

List the requirements in tabular form (do not forget to list important NF requirements)

ID	Type (Functional Non Functional)	Description
1	F	**User** management: CRUD (Create, Read, Update, Delete) User, authorize and authenticate User, login logout
2	F	**Training** management: CRUD Training, start training, end training, compute distance, compute avg speed
3	F	**Part** management**:** CRUD part, attach/detach part to training, start part, end part, compute distance, compute avg speed
4	F	**Heart rate:** read heart rate (== read HR sensor), attach heart rate to training
5	F	**Picture:** read picture (== read camera output), attach picture to training
6	F	**Waypoint :** read waypoint (== read GPS sensor), attach waypoint to part/training
7	F	**Summary** management: create/show heart rate summary chart / route on map chart, altitude chart, speed chart
8	F	**Friend** management: attach / detach (friend) user to user; define trainings that a friend can access
9	NF	**Privacy,** all data of a user should be accessible to the user only (unless otherwise defines, see req 8)
10	NF	**Performance,** all functions should complete in <0.5 sec

Define one scenario describing a user who logs one training with two parts (laps)
Precondition: User U is registered

Postcondition: Training T is available, with parts P1 and P2

Step	Description	Req ID
1	U logs in, is authorized	1
2	U creates new training T	2
3	U starts training T	2
4	U stops part (part P1 is created and attached to T)	3
5	U stops training T (part P2 is created and attached to T)	3

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

```
int showPicture(int lat, int long, char* filename)
```

This C function receives the full pathname of a file in Windows format (filename) that contains a picture in jpg format. It receives also latitude and longitude of the picture, expressed as integers between -1 and 1. If the parameters are acceptable the function shows the picture on screen and returns 1, otherwise returns 0.

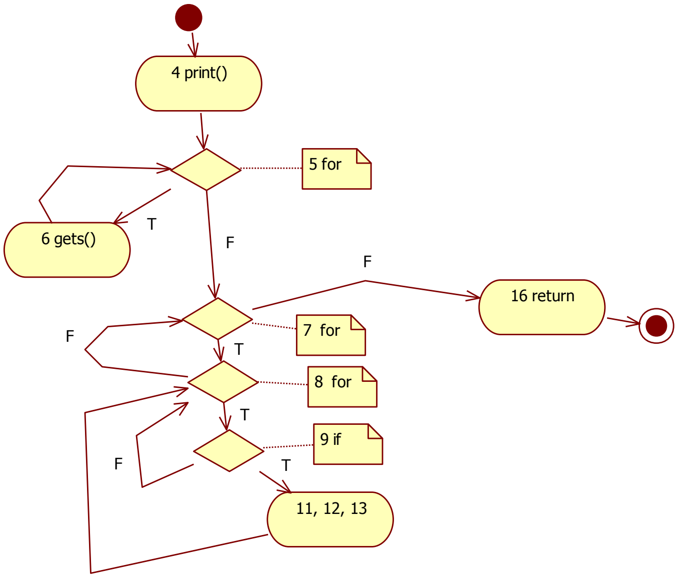
Ex. showPicture(0,0, C:/Pictures/mountain.jpg) → 1
showPicture(-2,0, C:/Pictures/mountain.jpg) → 0

Lat	long	filename	Valid / invalid	Test case
[minint, -1[	[minint, -1[	correct	I	
		not correct	I	
	[-1, 1]	correct	I	
		not correct	I	
	]1, maxint	correct	I	
		not correct	I	
[-1, 1]	[minint, -1[	correct	I	
		not correct	I	
	[-1, 1]	correct	V	T(0,0, C:/Pictures/mountain.jpg) → 1 boundary T(-1,0, C:/Pictures/mountain.jpg) → 1 T(0,1, C:/Pictures/mountain.jpg) → 1
		not correct	I	T(0,0, XDE#mountain.jpg) → 0
	]1, maxint	correct	I	
		not correct	I	
]1, maxint	[minint, -1[	correct	I	
		not correct	I	
	[-1, 1]	correct	I	
		not correct	I	
	]1, maxint	correct	I	
		not correct	I	

A possible improvement is to define more cases on filename:
Wrong syntax for pathname
File exists / no exists
File is/is not jpeg

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**.

```
1  int main(){
2     int i,j;
3     char str[10][50],temp[50];
4     printf("Enter 10 words:\n");
5     for(i=0;i<10;++i)
6         gets(str[i]);
7     for(i=0;i<9;++i)
8        for(j=i+1;j<10 ;++j){
9           if(strcmp(str[i],str[j])>0)
10           {
11            strcpy(temp,str[i]);
12             strcpy(str[i],str[j]);
13             strcpy(str[j],temp);
14           }
15    }
16 return 0;
17 }
```



Coverage type	Number of test cases needed to obtain 100% coverage	Coverage obtained with test cases defined (%)	Test cases defined
Node	1	100%	T1
Edge	1	100%	T1
Multiple condition	NA		
Loop	3 loops, to be covered independently 3 * 3 = test cases	Line 5, 1/3 (many) Line 7 1/3 (many) Line 8 2/3 (1, many) All loops are not controllable But loop line 8 is executed 1 times (i= 8) and many times (i = 0 to 7)	T1
Path	1 path if no if at line 9, considering line 9: < 9 *9 *2 paths in theory feasible, but ..		

Write test case ID (t1, T2 ..) in the rightmost column, and test cases here
T1 ({ BABZ, AABC , BABZ, BABZ, BABZ, BABZ, BABZ, BABZ, BABZ, BABZ })
 (some words to be exchanged, some not, this covers all edges – no control on loops)
The code does not work for words longer than 50 chars, none of the techniques discovers this defect.

4 (1 points) – A project is estimated to require 60 person months for development. What could be the calendar duration for development?

Depends on number of people working, 3 people, 20 calendar months, 4 people 15 months
But there is a limit on the number of people (ex 20 people is unrealistic, so 3 months unfeasible)

5 (1 points) – A software product is developed custom for a bank. Development takes 18 months, operation and maintenance 10 years. Where do you expect to have the larger part of costs?

Maintenance, because 10 years is way longer than 18 months, evolutive, corrective and enhancement maintenance will likely require more effort than initial development.

6 (1 points) – Describe shortly the Function Point method.
See slides

7 (1 points) – Describe shortly the ‘incremental’ software process

See slides about process (this is not about incremental integration)

8 (1 points) – Describe shortly the ‘Adapter’ Design pattern

See slides