

Software Engineering

Books or notes are **not** allowed.

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

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Electric scooter (monopattino) – shared

In many cities it is possible to use electric scooters, in shared mode. Each scooter has a computer with touch screen, gps and mobile communication chip. The computer can interact with users and with a central server.

Users must install a dedicated app on their mobile. Through the app they can define an account, subscribe and pay for the service, find the closest scooter, start and finish using the scooter, and more.

The whole system is therefore composed of scooters (each with a computer), app for users, central server.

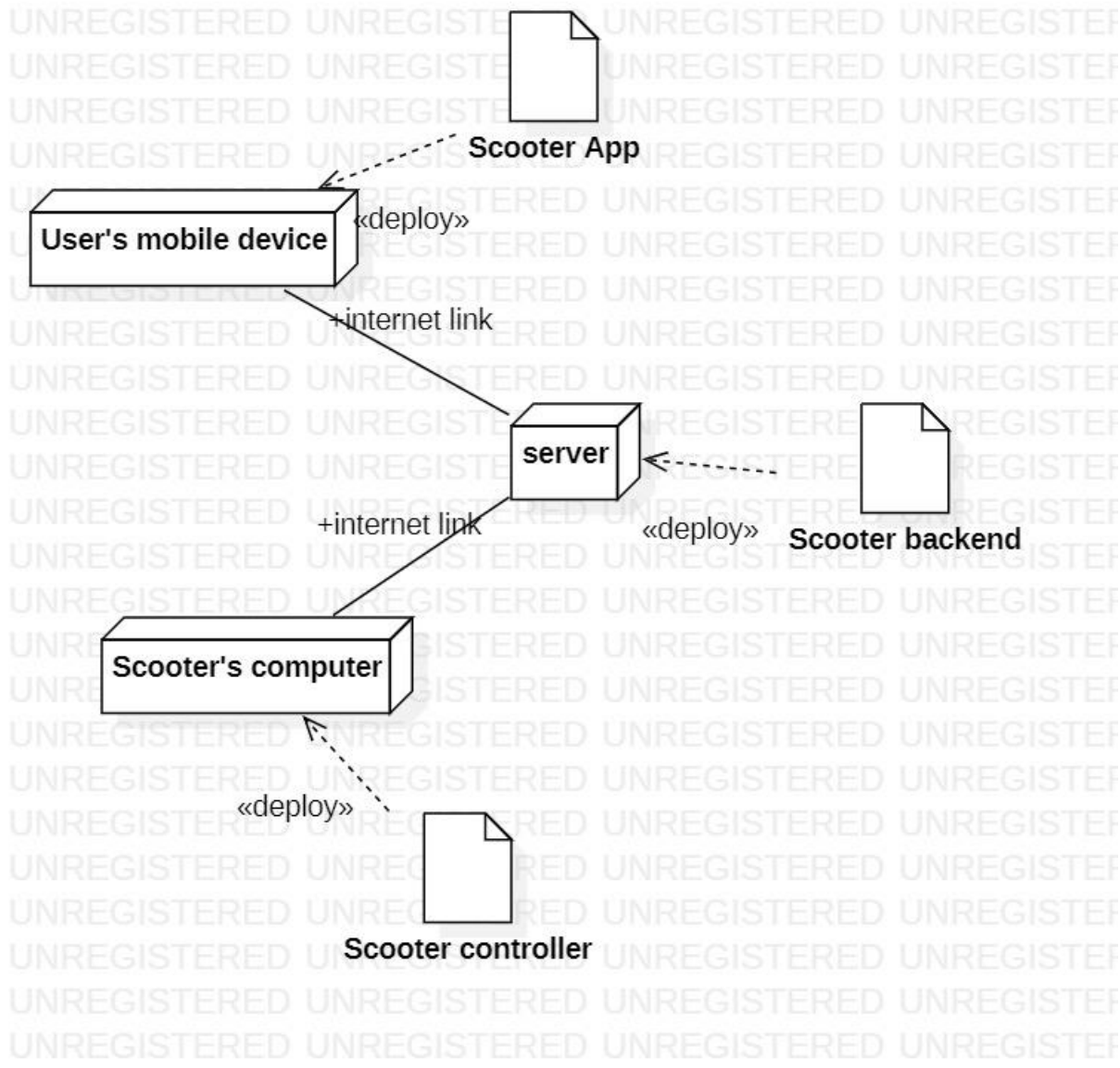
In the following consider the whole system.

1 define the functional requirements

ID	Description
FR1	User management (admin, user) 1.1 create / modify / delete account for a user 1.2 attach payment method (credit card) to account 1.3 debit / credit account 1.4 authorize / inhibit account 1.5 login logout
FR2	Scooter management (admin) 2.1 Add / delete scooter 2.2 Change scooter status (usable, not usable) 2.3 Monitor status of scooter (charge, autonomy, position, faults)
FR3	Ride management (admin, user) 3.1 start ride / unlock scooter 3.2 end ride / lock scooter 3.3 compute cost of ride 3.4 attribute cost to user
FR4	Recharge management (admin) 4.1 plan recharge route for a team (a team with a truck runs a certain route changing batteries to the scooters on the route) 4.2 plan recharge teams (define teams available on certain time frame, ex week) 4.3 allocate routes to team 4.4 monitor recharge team (status of work of teams and scooters recharged)
FR5	Pre-ride management (user on mobile app) 5.1 show available scooters on a geo area 5.2 reserve/unreserve scooter 5.3 search scooter (by distance, by charge, by type)
FR6	Offer management (admin) 5.1 define / modify usage plans / subscription types / offers and discounts 5.2 associate usage plan to account

Other possible requirements could be about evaluation of service/scooter, evaluation of users, overall usage statistics for admin

2 Define the deployment diagram



3-White box

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 is_number(char A[], int n){
2.     int i;
3.     for(i=n-1; i>=0; i--){
4.         if( !( isDigit(A[i]) || isComma(A[i]) || isDot(A[i]) )){
5.             return 0;
6.         }
7.     }
8.     return 1;
9. }

```

Coverage type	Number of test cases needed to obtain 100% coverage	Coverage obtained with test cases defined (%)	Test cases defined
Node	2	100	T1(['1', '2', '3'], 3) T2(['a', 'b', '3'], 3)
Edge	2	100	T1 T2
Loop line 3	3	100	T1 loop n times T3(['1'], 1) loop once T4([], 0) loop zero times
Multiple condition line 4	8	50 TTT or TTF TFT FTT are not feasible FFF TFF FTF FFT	FFF T1 TFF T2 FTF T5 (['.', 1] FFT T6 (['.', 1])
Path	Depends on length of array, feasible only if a max length is defined	Close to zero with the 6 test cases defined	

4 Focusing on software design, describe the concept of ‘coupling’ and make an example

See slides

5 Describe briefly the inspection technique applied to source code

See slides

6 The software application (app for user + server side) has been developed custom for the company managing the e-scooter service, over a 12 months period by 3 full time people. The company wants to operate the service for at least 7 years, and plans 1.5 FTE per year for maintenance.

Where do you expect to have the largest part of costs ? (consider 1 year development +7 years maintenance, consider software costs only)

Development $12 \times 3 \times 1 = 36$ person months = 3 person years

Maintenance: $12 \times 1.5 \times 7 = 126$ person months = 10.5 person years =

Maintenance costs are (according to these estimates) the major cost source

7 Describe shortly the ‘Adapter’ Design pattern

See slides