Dipartimento di Elettronica, Informazione e Bioingegneria
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Software Engineering II

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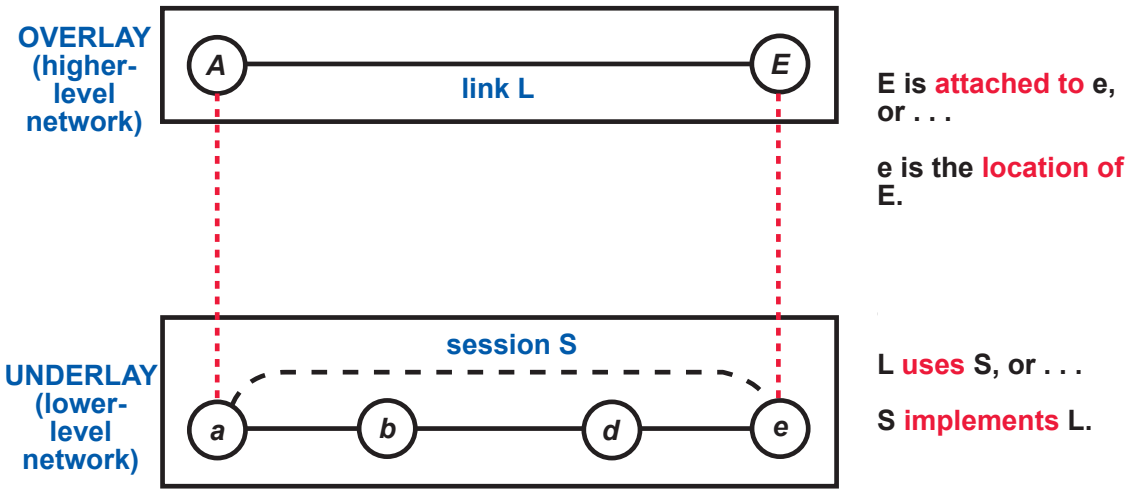
Last Name
First Name
Id number (Matricola)

Note

1. The exam is not valid if you don't fill in the above data.
2. Write your answers on these pages. Extra sheets will be ignored. You may use a pencil.
3. Incomprehensible hand-writing is equivalent to not providing an answer.
4. The use of any electronic apparatus (computer, cell phone, camera, etc.) is strictly forbidden.
5. You cannot keep a copy of the exam when you leave the room.

Question 1 Alloy (7 points)

Observe the following figure. It describes a communication system composed of an overlay network linking *nodes* A and E. This overlay is a virtual network built on top of an underlay network. In the figure, the underlay network is composed of four nodes (a, b, d, and e) and link L exploits the links between a, b, d and e in the underlay network to ensure that A and E can communicate.



Consider the following Alloy signatures:

```
sig Network {uses: lone Network} {this not in uses}

sig Node {
        belongsTo: Network,
        isLinkedTo: some Node,
        isAttachedTo: lone Node
} {this not in isAttachedTo and this not in isLinkedTo}
```

A) Explain the meaning of these signatures with respect to the figure above and indicate which elements in the figure are not explicitly modeled by the two signatures.

B) Write facts to model the following constraints:

- Linked nodes have to be in the same network
- A node belonging to a certain network can only be attached to nodes of the corresponding underlay network
- If a network is an overlay one, then there should not be nodes in this network that are not attached to other nodes
- A network should always contain some nodes

C) Write the predicate isReachable that, given a pair of Nodes, n1 and n2, is true if there exists a path that from n2 reaches n1, possibly passing through any intermediate node.

Solution to part B and C

```
fact linkedNodesInTheSameNetwork {
        all disj n1, n2: Node | n1 in n2.isLinkedTo implies #(n1.belongsTo & n2.belongsTo) > 0
}
```

```
fact isAttachedToInConnectedNetworks {
	all disj n1, n2: Node | n1 in n2.isAttachedTo implies #(n1.belongsTo & n2.belongsTo.uses) > 0
}

fact overlayNodeShouldBeAttached {
	all ntw: Network | some ntw2: Network | ntw2 in ntw.uses implies all n: Node | n.belongsTo =
ntw implies n.isAttachedTo != none
}

fact notEmptyNetwork {
	all ntw: Network | some n: Node | n.belongsTo = ntw
}

//n1 is reachable from n2
pred isReachable[n1: Node, n2: Node] {
		n1 in n2.^isLinkedTo
}
```

Questions 2 JEE (7 points)

A software system stores a set of articles from various authors. A user of the system should be able to:

1) visualize the titles of the articles published by a given author;
2) visualize the titles of all articles (even from different authors) published within the same year;
3) read the text of a desired article;
4) look for the authors who have published more than 'N' articles up to the current date;
5) look for authors whose articles have been read more than 'M' times through this software system.

A) You are asked to design the articles management system using JEE. In particular, you should identify the required JEE entity/session beans that you wish to have in order to implement the system. For each bean, you should specify the type (e.g., stateful session bean), the requirements it is intended to fulfill (among those listed above), the attributes and methods it provides (you are not required to implement methods).

B) Assume that, after an initial phase of free usage, the system is updated in order to include the following payment policy: at the end of each user session, the user is asked to pay 1.5$ for each article that she has read during the session. Discuss how you wish to modify the previous design in order to accomodate this new requirement.

Question 3 Function Points and testing (6 points)

A company managing gasoline stations aims at developing an information system.

This system visualizes the status of all gasoline stations in terms of quantity of gasoline available and sales. Such data are acquired from sensors located within the gasoline tanks and from the cash registers.

The system, also manages the process through which a customer refuels his/her car: the customer selects a pump and an amount to pay, inserts his/her credit card to enable the payment, the system after getting the confirmation of the transaction from the bank, enables the selected pump, the customer refuels the car and, optionally, inserts a fidelity card. In this case, the points corresponding to the gasoline purchase have to be added to this card.

Finally, the system alerts the supplying department about the need to buy new gasoline when it goes below a certain threshold.

A) Identify: **Internal Logic Files**, **External Inputs** and, if they exist in this case, **External Interface Files**. Define the complexity of each of them providing a motivation.

B) You are planning the system testing activities for this piece of software. Define the main test cases that you think are needed in this case. For each test case define the inputs, the expected system state before the execution of the test and the expected result.

Solution

ILF
GasolineStation: Simple complexity since the structure of this data is simple and we can assume to have a limited number of gasoline stations to manage.
Tank: Simple complexity as the structure of this data is very simple
User (includes the fidelity card): Average complexity as the data structure is simple but we can have a relatively large number of users.

ELF
Streams generated by tank sensors: Simple complexity as it can be seen as a single data transmitted by the sensor when the gasoline goes below a certain threshold.
Data acquired by cash register: Average complexity as they
Confirmation of credit card transaction

External inputs
Refuel request from user