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 (8 points)

A computer's memory can be modeled in Alloy based on the following signatures:

```
sig Address {}
sig Value {}
sig Computer {
    memory: Address -> lone Value
}
```

Using Alloy, you are to:

1) define a fact that states that the memory of the computer is never empty, that is, at least one memory address exists that is not uninitialized
2) model the behavior of predicate
   delete `[c: Computer, addr: Address, c': Computer]`
   such that memory at address `addr` becomes uninitialized
3) model the behavior of predicate
   move `[c: Computer, oldAddr: Address, newAddr: Address, c': Computer]`
   such that, if a value exists in address `oldAddr` and `newAddr` is uninitialized, the value is moved to `newAddr` and `oldAddr` becomes uninitialized; nothing changes if `oldAddr` is uninitialized
4) change the signatures above to extend the model to the case of a computer with multiple independent memory segments

Questions 2 JEE (4 points)

A simple online store uses JEE to handle warehouse state and user purchases. Administrators can manipulate the information in the database using the `AdminBean` shown below. The Bean uses the entity `Item`, whose implementation is not shown.
Users rely on a different `CartBean` to handle the cart during online shopping. During a session, such a bean allows users to

i) insert an item in the cart
ii) compute the cost of all items in the cart at a certain point in time

You are to implement `CartBean` using JEE. You can omit exception handling.

```
@Stateless
public class AdminBean {
    @PersistenceContext(unitName = "online-store")
    private EntityManager em;

    public AdminBean() {}

    public Item getFromId(String itemId) {
        try {
            return (Item) this.em.createQuery("SELECT i FROM Item i WHERE i.itemId=:itemId")
                    .setParameter("itemId", itemId).getSingleResult();
        } catch (NoResultException ex) {
            return null;
        }
    }

    public Item insertItem(String description, Integer quantity, Double pricePerUnit) {
        Item i = new Item();
        i.setDescription(description);
        i.setQuantity(quantity);
        i.setPricePerUnit(pricePerUnit);
        em.persist(i);
        return i;
    }

    public Item updateItemQuantity(String itemId, Integer newQuantity) {
        Item toUpdate = getFromId(itemId);
        if (toUpdate != null) {
            toUpdate.setQuantity(newQuantity);
            em.persist(toUpdate);
            return toUpdate;
        } else {
            return null;
        }
    }

public List<Item> getItemList() {
        try {
            return (List<Item>) this.em.createQuery("SELECT i FROM Item i").getResultList();
        } catch (NoResultException ex) {
            return new ArrayList<Item>();
        }
    }

}
```

Question 3 Planning and Requirement Analysis (8 points)

You are asked to design a simple project management tool. The tool should:

1. Handle information about projects (name, goal, budget, tasks) and people (name, role, allocated projects, allocated tasks, salary);
2. Allow people with role "project manager" to allocate other people to projects and tasks;
3. Allow people to visualize the tasks they are working on;
4. Allow people to input the level of completion of the tasks they are working on;
5. Allow the "project manager" to compute the human cost of a task based on the salaries of people allocated to it and the time they worked on that task.

You need to:

1) Compute the number of function points the tool will account for, using the table below

Function types	**Weights**		
	Simple	Medium	Complex
N. Inputs	3	4	6
N. Outputs	4	5	7
N. Inquiry	3	4	6
N. Internal Files	7	10	15
N External Files	5	7	10

2) Define two use cases that you think are paradigmatic in the analysis