National University of Computer and Emerging Sciences
Lahore Campus

Formal Methods (SE2003)

Date: 6th April, 2024

Course Instructor(s)

Dr Wafa Basit

Student Name	Roll No	Section	Student Signature

Sessional-I Exam

Total Time: 1 Hours
Total Marks: 35
Total Questions: 2

Instructions

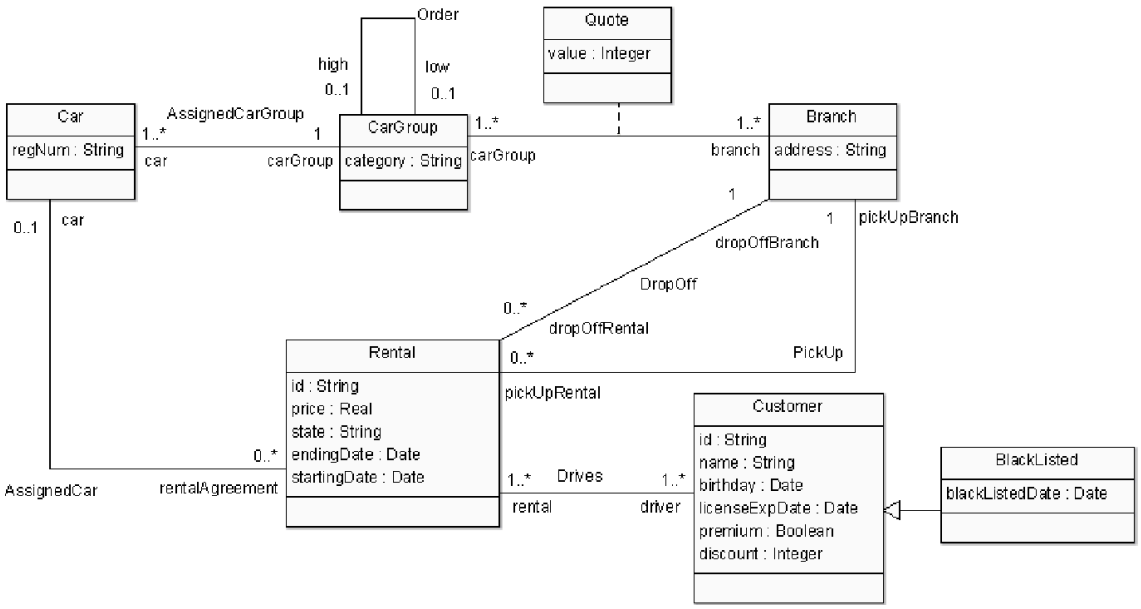
- Question # 1 should be solved on the question paper. Attach the question paper with the answer sheets.
- Make assumptions where necessary
- In case of multiple solutions, mention the final one
- Use of lead pencil is not allowed.

Question # 1: Fill in the blanks (17 Points)

1. The context may be denoted within the expression using the keyword ----------.
2. Keyword ---------- denotes the output of the operation, if any.
3. The `@pre' postfix is allowed only in ----------.
4. Collection is an abstract type with four concrete collection types:----------,----------,---------- and ----------.
5. In OCL type system every object has a top type, namely ----------.
6. Rules of behavior preservation for the refactoring process are derived by----------,----------,---------- and ----------.
7. ---------- are specialized clients in the context of refactoring.
8. Refactoring improves the internal ----------of the software.
9. Composite refactorings are composed of ----------refactorings.
10. In ----------refactoring it is difficult to separate the impact of refactoring process from the other development task.
11. A ---------- is an opportunity to refactor.

Question # 2: (18 Points)

EU-Rent presents a car rental company with branches in several countries that provides typical rental services.



This excerpt contains information about the rentals of the company (Rental class), the company branches (Branch class), the rented cars (Car), the category to which they belong (CarGroup) and the customers (Customer) that at some point in time may become blacklisted (BlackListed) due to delayed car returns,unpaid rentals, etc. Each rented car has one or more registered drivers and a pickup and drop off branch assigned.

Write down OCL constraints for the following (3 points each)

1. All **quotes** must have a positive value.
2. **BlackListed** customers have all rentals before the **blackListedDate**.
3. **Premium** customers get a 30% **discount** if their number of **rentals** are greater then 5. Otherwise, they get 15% discount.
4. Assume that there is a Boolean variable named **MostPopular** in the Car class. Which would be true if any particular car has maximum **rental agreements**.
5. Describe precondition of the method newRental. The **customer** can rent a car if his **license expiry date** is greater then *endingDate*

   context Rental::newRental(id:Integer, price:Real, startingDate:Date, endingDate:Date, customer:Customer, carRegNum:String, pickupBranch: Branch, dropOffBranch: Branch)

6. For all **rentals** where **startingDate** is same as **endingDate**, **pickUpBranch** is same as **dropOffBranch**

-------Good Luck-----