

Modeling with UML, with semantics

Exam questions

Question 1 [4 Scores]

How can model-driven development save time in the software development process?

Question 2 [4 Scores]

What is the relation between the M2 and M3 level of the metamodeling hierarchy? Why is there no M4 level?

Question 3 [4 Scores]

Consider the following modeling tasks:

- Modeling the behaviour of an object
- Modeling the interaction between objects
- Modeling the static structure of objects
- Modeling the constraints on an object

Which of the following languages/notations would you use for which modeling task?

- UML class diagrams
- UML state machines
- UML sequence diagrams
- OCL

Question 4 [15 Scores]

Draw a UML class diagram and write OCL formulas that together model the following situation:

- There are domestic flights and international flight lines.
- Each flight line has many specific flights.
- Each flight has a number, take-off time and landing time.
- There are small and large planes.
- At most one plane is assigned to a flight — there can be flights without any plane assigned to them (yet).
- No plane can be used for two flights at the same time.
- Small planes are used only for domestic flights.
- There is an operation to assign a plane to a specific flight. The operation can only be executed provided that the above mentioned constraints are fulfilled.

Focus on the notions given above. Do not introduce extra stuff that is not mentioned.

Question 5 [3 Scores]

Draw two object diagrams for the class diagram from question 4, one that satisfies *all* constraints and one that violates as many constraints as possible. Give reasons why the second object diagram violates the constraints.

Question 6 [3 Scores]

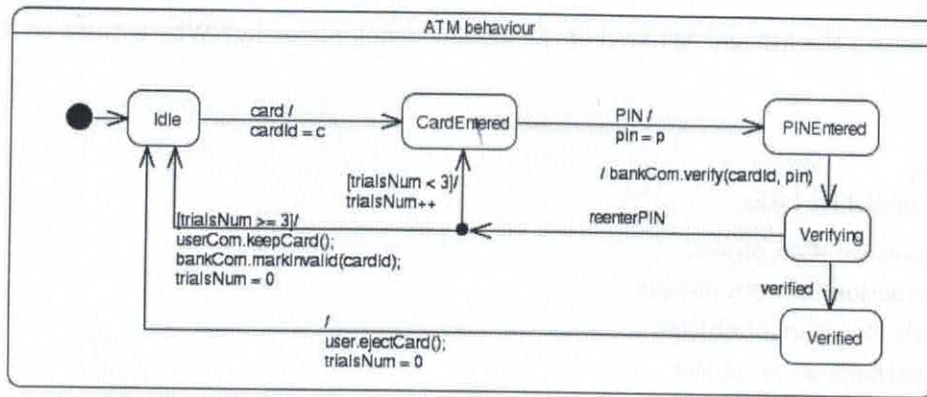
What is the semantics of a UML sequence diagram?

Question 7 [7 Scores]

Draw a state machine that captures the following situation: There is a vending machine selling chocolate. The user has to choose between two different types of chocolate bars (small and large), and then to insert a coin (20 cents for a small, 50 cents for a large bar). Finally, the machine releases the chocolate bar. The machine can also run out of chocolate; in this case, the user should not be able to even choose chocolate. How many different state configurations does the state machine have?

Question 8 [5 Scores]

Consider the following state machine:



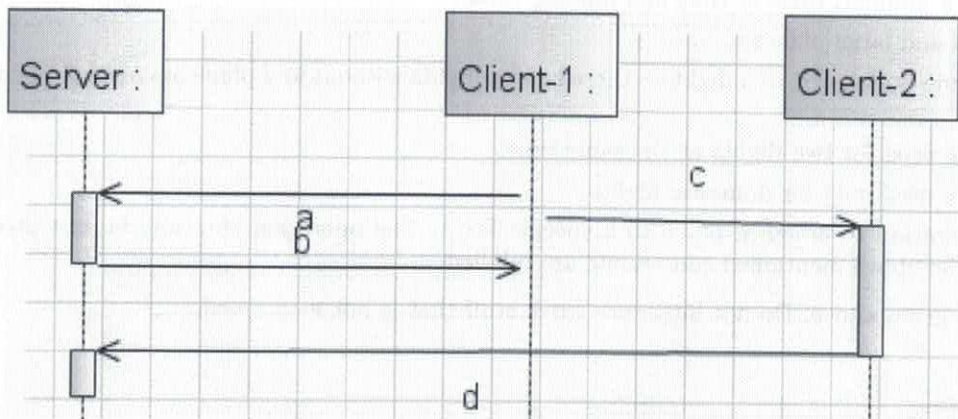
Discuss the possibility of infinite runs in the associated syntactic labeled transition system and in the associated semantic labeled transition system. [Hint: the semantic labeled transition system takes care of the guards, the syntactic one does not.]

Question 9 [4 Scores]

Draw a sequence diagram showing the following interaction between a client and a server: the client sends a synchronous request to the server. The server responds immediately with a job number. Later, the server responds with the job data.

Question 10 [9 Scores]

Consider the following sequence diagram:



Let us denote the event of sending of message *a* with *snd(a)*, that of receiving of message *a* with *rcv(a)*. Similarly for messages *b*, *c* and *d*.

- (a) What are the dependencies among the events?
- (b) Give five possible traces.

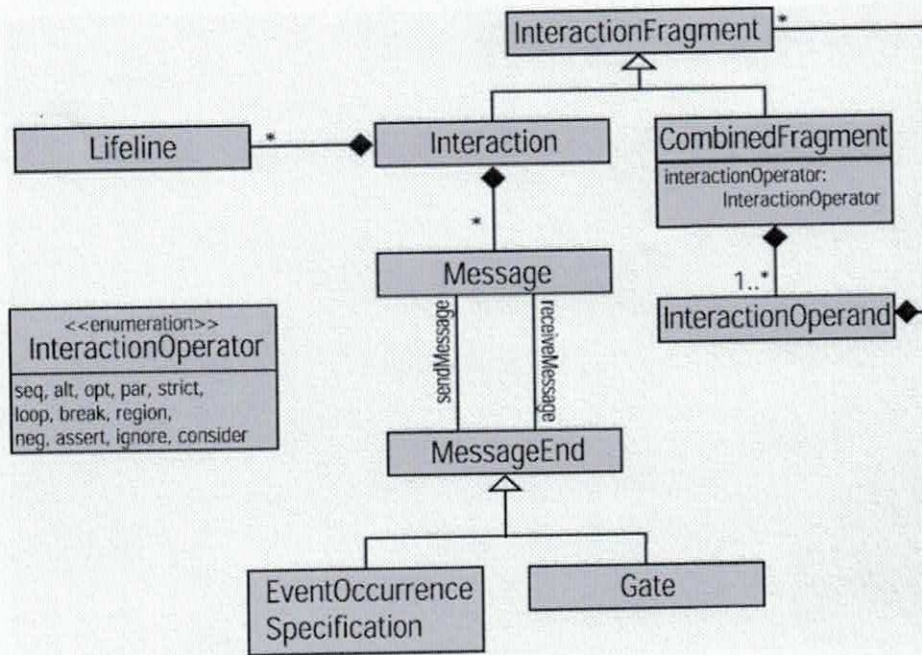
Question 11 [5 Scores]

Correct or not? (No reasons need to be given.)

- (a) A state can be part of a state machine.
- (b) A state machine can be part of a state.
- (c) A state machine can be part of a class diagram.
- (d) A pre condition must always be fulfilled.
- (e) A post condition describes current state of a post office.

Question 12 [7 Scores]

Consider the following part of the metamodel for UML sequence diagrams:



Explain how your sequence diagram from question 9 conforms to this metamodel. Which elements of your sequence diagram conform to which metaclasses, and to which meta-associations?

