Exam

"UML for Embedded Systems" Course

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Duration: 2h

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Authorized documents: course slides and notes you've taken during course and lab sessions.

A rate is provided for each question. An additional point is given as a general appreciation, including the written quality and skill. Don't spend to much time on exercises I and II because exercise III is quite long.

I. Understanding of the Course: « parts » (3 points) ~15mn

1) Give the definition of UML "parts". What is the relation between a "part" and a class? And between a "part" and an object?

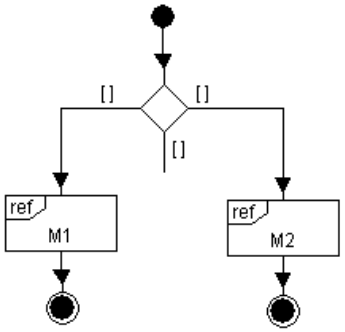
2) Use a small example of your own (not provided in the course) to illustrate the purpose of "parts".

II. Scenario Implementability (4 points) ~30mn

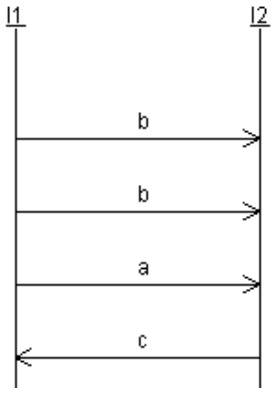
1) Explain in a few lines the scenario implementability issue.

2) Demonstrate the (non)-implementability for each scenario provided hereafter.

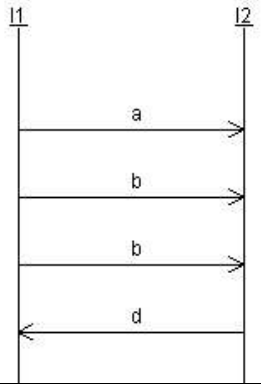
a)



IOD

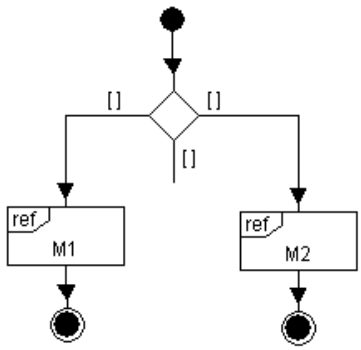


M1



M2

b)



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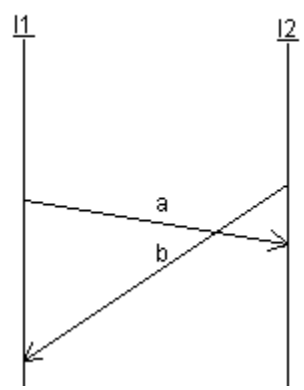
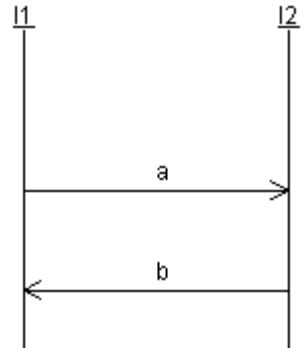
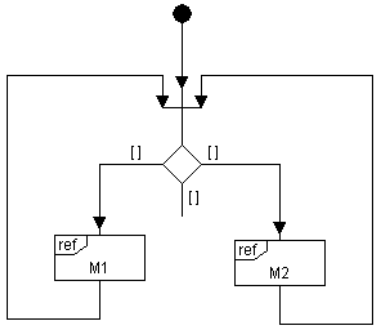


M1



M2

c)



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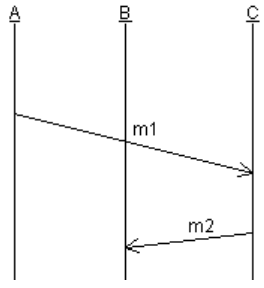
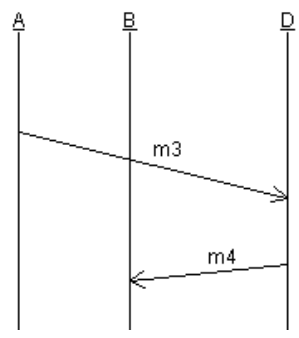


M1



M2

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III. Modeling Exercise (12 points) ~70mn

The goal of this exercise is to model the software and hardware parts of a coffee machine whose characteristics are provided just below. The time being short to perform this modeling, you may omit a few modeling details as long as you explicitly mention which details you have omitted and why you have omitted these ones. At last, don't forget to comment your diagrams, grading takes into account at the same level comments and diagrams.
The coffee machine to model works as follows (the TURTLE modeling of this machine has been introduced during a course session):
The coffee machine can deliver tea or coffee once two coins have been inserted. The first coin is ejected if a second coin is not inserted before 50 time units. Once two coins have been successfully inserted, the two buttons "coffee" and "tea" are activated during 100 time units. If no user selects a drink before the expiration of this delay, then, both coins are ejected, both buttons are inactivated, and the machine is reset to its initial state. Otherwise, the appropriate drink is delivered to the user, and both buttons are inactivated. The preparation of tea and coffee respectively takes 50 and 70 time units.

1) Analysis ~25mn

a) Make the use case diagram of this machine. (1 point)

b) Make two scenarios, one for the nominal case, and one for an error case. (1 point)

c) Using the technique of "words in the text", propose a collection of classes and objects for this system. (1 point)

d) Refine the two previously performed scenarios. Note that these scenarios should clearly express time constraints. (1 point)

2) Design ~35mn

a) From your analysis diagrams, propose a class diagram containing class relations such as associations, aggregations and so on, and also multiplicity. (2 points)

b) Perform the composite structure diagram of this system. Your diagram should model communication channels between system entities. (2 points)

c) Make the state diagram of the most important / complex class of your system. (2 points)

3) Modeling time constraints ~10mn

a) For the previous coffee machine, we have assumed that the drink preparation delay is deterministic. Now, we assume that the delay for preparing coffee is [45, 70] (non deterministic delay) and the one for preparing tea is [60, 90] (non deterministic delay). Modify all necessary diagrams of the UML analysis and design you have just performed. What are the limitations of your new modeling, or the difficulties you have encountered to perform this new modeling?

b) Bonus question. The TURTLE UML Profile enhances UML with operators dealing with such timing constraints. Enumerate these operators and propose a modeling of the state machine made at step 2)c) under the form of TURTLE activity diagrams.