



## Object-Oriented Analysis and Design

### Exam Winter Semester 2006/2007

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Name: \_\_\_\_\_

Student Number: \_\_\_\_\_

#### Rules:

1. The exam is closed book. That means that the only things you are allowed to have on your desk or use during the exam are pens and the exam itself.
2. All phones off. A switched on phone is considered cheating.
3. Keep your eyes on your own work.
4. Cheating will cause you to fail this exam.

#### Additional information:

- The exam will take 90 minutes.
- Each problem is associated with a number of points. This is also the amount of time in minutes we expect you to take for the answer (the total sum is 75).
- Please put your student identification as well as a passport/official id card on the table. We need to check these.
- Don't forget to put your name and student number on each page.
- If you draw into existing diagrams, please think *before* you draw to keep your answer readable.
- We took the utmost care to make the English and German version semantically identical. In case of doubt, you may inspect both versions on the front desk.
- We have more paper, should you need some, ask.

**Good luck!**

**Task 1: Object Orientation.**

(a) Summarize the differences between “implementation inheritance” and “interface extension”. (4 pts)

(b) Explain whether overriding or overloading allows achieving polymorphism. (4 pts)

**Task 2: Development Process and Analysis.**

(a) Describe the justification behind Bohem's "Spiral Model". (5 pts)

(b) Explain the meaning of the following sentences in the context of the Unified Process (continue your answer on the reverse of this sheet if needed):

*"Construction builds the system in a series of iterations.  
Each iteration is a project in itself"*

(5 pts)

**Task 3: From Analysis to Design.**

(a) When performing OO modeling, three possible views can be recognized: conceptual, design, and implementation view. In this context, explain the meaning of the sentence “*Views are part of the Unified Process, not of UML itself*”. (4 pts)

(b) Describe what information can be provided by an association in a UML class model. (4 pts)

(c) Mention at least three visual notations that can be used when modeling behavior. (3 pts)

**Task 4: Modeling Tools.**

**(a)** When considering tools for different phases of the software development process, the issue of transitioning models from one phase to the next comes up. Is it possible to automate this transition? Explain why or why not.

(5 pts)

**(b)** What is understood under the term “roundtripping”?

(3 pts)

**Task 5: Design Phase.**

(a) What are “swimlanes” (in activity diagrams) used for? (2 pts)

(b) Consider a (simplified) monitoring application whose GUI is depicted in Figure 1. The application is used in a bakery to control two ovens (let’s say, one for cooking cookies and the other for bread). This application receives events from each oven (turned on/off, temperature change) which it displays on the thermometers shown. In case an oven is off, its group of GUI elements must be grayed out.

The monitoring application must keep timers in order to fire an alarm whenever any of the ovens has been on without interruption for more than 15 min at a temperature of 250°C or higher. The monitoring application itself sends no signals to the ovens, it lacks all control functions. Prepare:

- (a) the class diagram for the ovens and the monitoring application
- (b) the statechart for the monitoring application to update the GUI.

Use draft paper to draw the diagrams (draft paper provided by the exam staff, not your own) and then copy the final version to the reverse of this sheet. (12 pts)

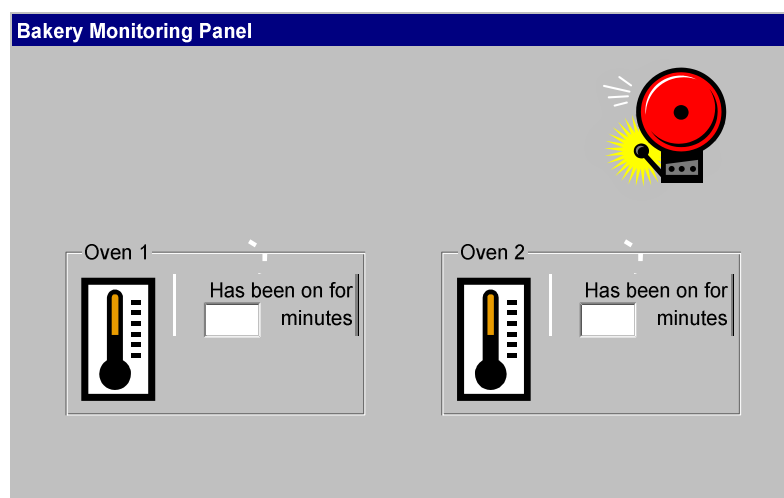


Figure 1

**Task 6. Diagrams**

(a) Please indicate whether the following statements are true or false. (Points are discounted for wrong answers, so if in doubt you may consider leaving fields blank instead of randomly ticking a checkbox) (6 pts)

	<i>true</i>	<i>false</i>
A collaboration diagram has more information than several statecharts.		
A state diagram must be associated to each package.		
A class diagram can be subclassed by a statechart to model behavior.		
A state diagram depicts all objects and their runtime relationships.		
States in state diagrams can be hierarchical.		
Objects can be shown in both activity and state diagrams.		
An activity diagram can depict a waterfall software process		
All transitions in a statechart are triggered by events		
There are “activity completed” events in activity diagrams		
The behavior of a system where each class has a complete statechart is still underspecified		
Concurrent execution cannot be shown in activity diagrams.		
Every activity diagram has one or more start activities.		

**Task 7: Design Phase Details – Alloy Logic.**

(a) One way of improving the quality of a software system consists in testing its implementation P to check if P does not deviate from the expected behavior. Another way consists in preparing a formal model F of the system (e.g. in Alloy) to explore states and state evolutions implied by F that fulfill certain predicates of interest. Mention the pros and cons of each approach.

(If needed, continue your answer on the reverse of this sheet) (6 pts)

(b) Figure 2 below represents in a schematic way a possible situation at runtime, where objects reference each other. The Java Virtual Machine has to determine which of these objects are not reachable from the root set of references, so as to collect them as garbage. Assume that an algorithm A (written in Java) is proposed to carry out this task. Please formalize in English (or in Alloy if you prefer) the correctness criteria of such algorithm, i.e. what should be true before and after its execution. Be precise in the formulation, an incomplete or imprecise correctness criteria is not useful. Although a real JVM makes a distinction between strong and weak references (as reproduced on the diagram), you may overlook that distinction and just consider that objects are linked with (plain) references. (12 pts)

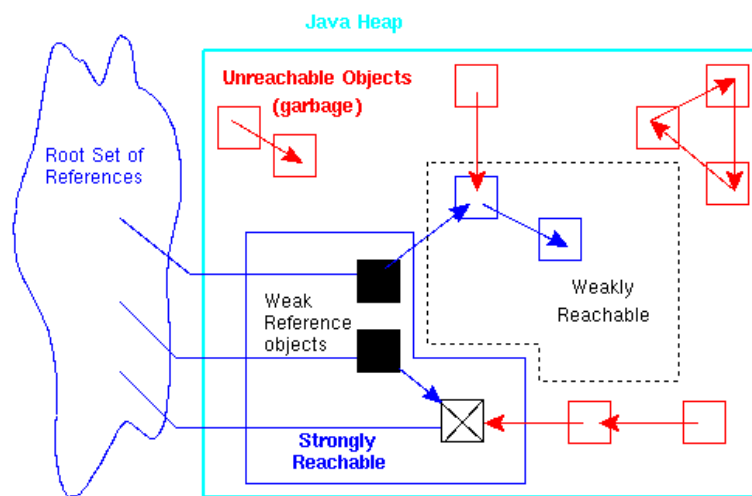


Figure 2