

Specification of Information Systems (233030)

Examination

23rd January, 2006

Explain your answers, yet keep your explanations precise. Long-winded answers are not appreciated.

1.
 - a. Define the following concepts: Subject domain and connection domain.
 - b. Identify the subject domain and connection domain of the following systems. Identify at least three entities and events in the subject domain.
 - b1. The course database of the faculty (VIST).
 - b2. The software controlling the entry and exit barriers of a parking garage.
 - c. Do all subject domain entities appear also in the context diagram of the system? Explain your answer.
 - d. The behavior of a reactive system can be described in terms of a non-atomic dialog. Explain how a (stimulus, response dialog) can be transformed into a transactional stimulus-response list.
2. The ERD in figure 1 shows that students can participate in an exam that is held on a particular date, and that belongs to a subject. Such a participation leads to a grade.

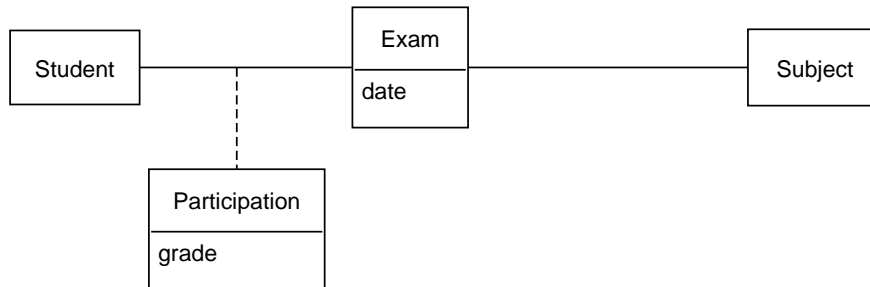


Figure 1: An ERD.

- a. Add cardinality properties to the figure, and explain each of them.
- b. Each exam can accommodate at most 30 participants, and each student can do exams for a subject maximally three times. Add cardinalities

to represent this. If a property cannot be represented by a snapshot cardinality, write it as a comment in the diagram.

- c. The grade that a student has for a participation in an exam, is known some time after the actual participation. Adapt figure 1 to represent this.
- d. The exam participation database is nationalized and we must now represent the fact that a student participates in an exam for a subject given at a particular university. One subject can be given at several universities. Adapt figure 1 to represent this.

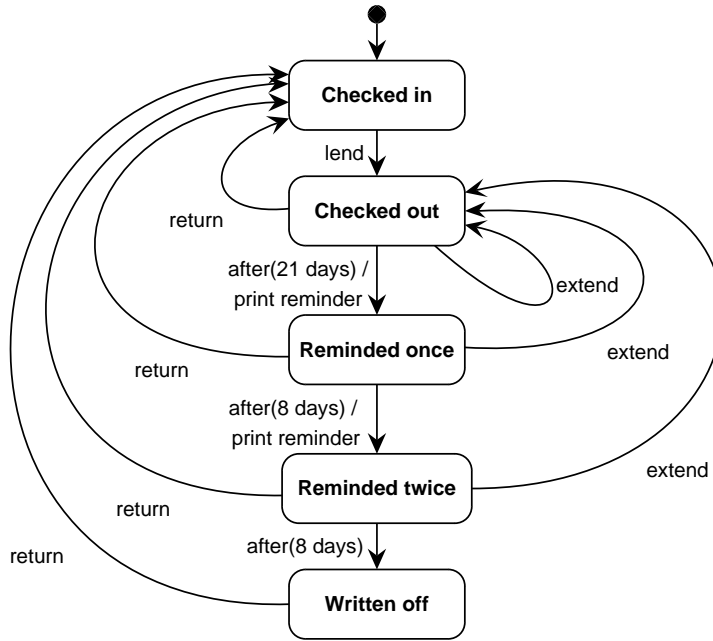


Figure 2: A Mealy diagram.

3. Figure 2 shows a statechart for a book-lending process. A book is either in or out, and when it is out, the library can remind the borrower to return or extend the loan. If a borrower does not respond to the second reminder, the book is written off. (No doubt you can think of numerous improvements to this simplistic process. But we will use this simple process for the exercise.)
 - (a) The diagram contains several $\text{after}(t)$ events. Explain the meaning of these events.
 - (b) Use state hierarchy to reduce the number of return and extend arrows in the diagram.
 - (c) Use a local variable to count the number of reminders. Take care that this variable has a correct value at all times.
 - (d) When a book is not checked in, it can be reserved. When it is reserved, its loan period cannot be extended. Add a parallel **Reservation** process to the diagram in which this is expressed.

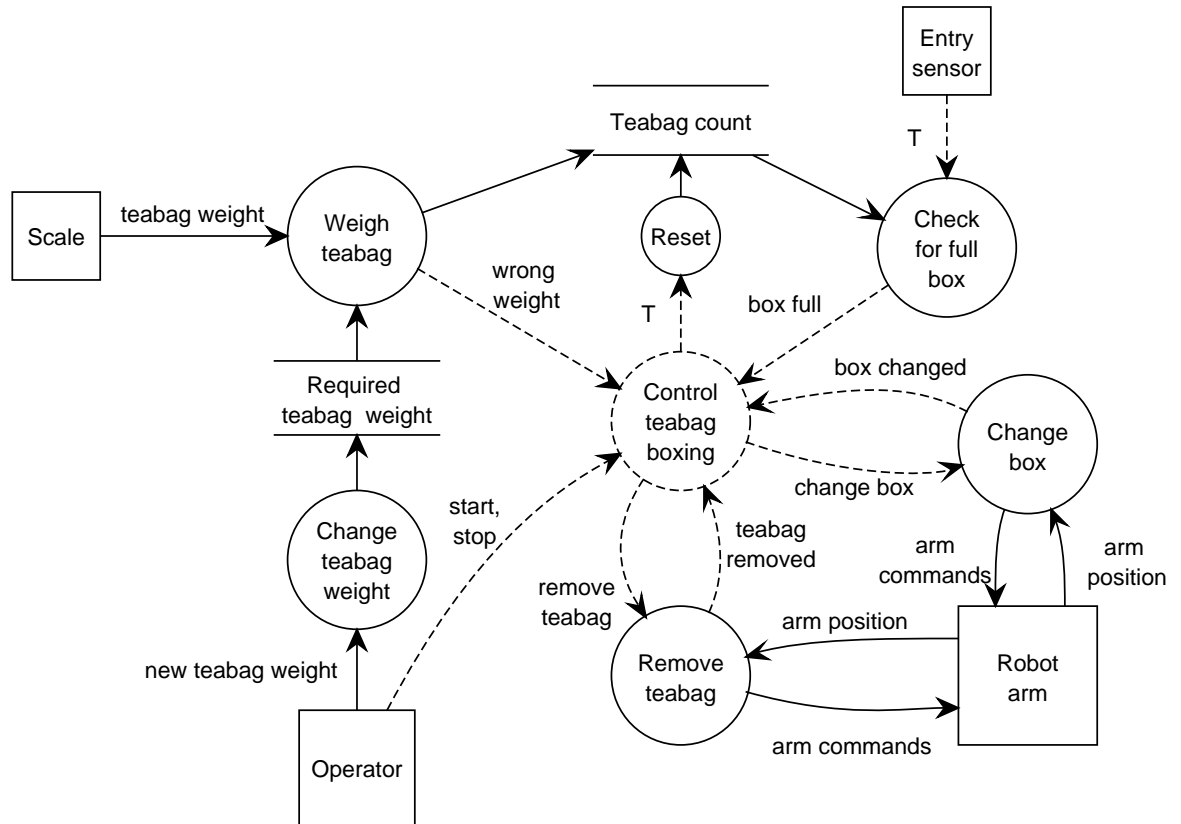


Figure 3: DFD for the control of a teabag boxing process.

4. Figure 3 shows a DFD of the control of a robot that boxes teabags. The bags arrive on a conveyor belt, passing a Scale that weighs them. If the weight of a bag is too high or too low, the robot must remove them. If the weight is within an acceptable interval, they are allowed to pass and then will drop from the conveyor belt into a box. If the box is full, the robot replaces it with an empty one.
 - (a) Explain the following decomposition guidelines, and show how each of them is applied in figure 3.
 - a1 Functional decomposition
 - a2 Event-oriented decomposition
 - a3 Device-oriented decomposition
 - a4 Subject-oriented decomposition
 - (b) Make an STD (Mealy diagram) for Control teabag boxing. Assume that the robot arm can replace a box fast enough before the next teabag arrives. List any other assumptions that you make.
 - (c) The control process is really engaged in two parallel processes. Change the architecture of figure 3 in the following way: Draw a communication diagram (not a DFD) that contains two processes, Control teabag

removal and Control box change. Explain which data store(s) of figure 3 are encapsulated in which component of this new architecture, and why you did that.

- (d) Starting from the same observation as (c), we decide to represent the Control teabag boxing process by a statechart with two parallel subprocesses, namely , Control teabag removal and Control box change. We also decide to use local variables if that clarifies the model. Draw this statechart, and draw the communication diagram (not DFD) that represents this architecture.

Problem	a	b	c	d	
1	4	4, 4	4	4	20
2	5	5	5	5	20
3	2	6	6	6	20
4	3, 3, 3, 3	5	5	8	30
					90

Grade = (10 + points)/10