Specification of Information Systems (233030) Examination

8th April, 2009

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

1. a. What is the difference between a reactive and a transformational system? Illustrate you answer by means of examples. pages 5-6 in the book

   b. (1) What is the difference between a connection domain of a reactive system and a subject domain of a reactive system? Illustrate you answer by means of examples. (2) Can the connection domain and subject domain of a system overlap? Illustrate you answer by means of examples. pages 14 and 19; also the glossary. Page s21 question 3. Yes they can overlap, the system may have to understand messages like (sensor X is giving reading R and sensor Y is giving reading S.

   c. What is the difference between a conceptual entity and a lexical entity? Illustrate you answer by means of examples. pages 15-16

   d. Can the subject domain of a reactive system be part of that system? Illustrate you answer by means of examples. figure 2.8 and explanation.

2. A Home Shopping Club offers its members the opportunity to buy very exclusive items. A member of the Club must order at least one item each quarter. Figure 1 shows two ERDs (i) and (ii) of this subject domain.

   (a) "A member of the Club must order at least one item each quarter." Is this correctly represented in each diagram? Why/why not? In (i) a member can skip a quarter, because the diagram allows any set of (member, item) pairs, regardless of quarter. In (ii) a member can be related to any set of orders and there is no constraint on the quarters of these orders.

   (b) Is it possible for member W.B. to buy a wrist watch for himself and a necklace for his wife in the same order? Why/why not?

   (c) Is it possible that member J.P. can order a design wrist watch Movado (type La Nouvelle) and then later in the same quarter order the same watch for a friend? Discuss for each diagram. In (i) it is not even possible to order the same item twice, regardless of quarter. In (ii) two orders can have the same quarters so the desired situation is possible according to b).

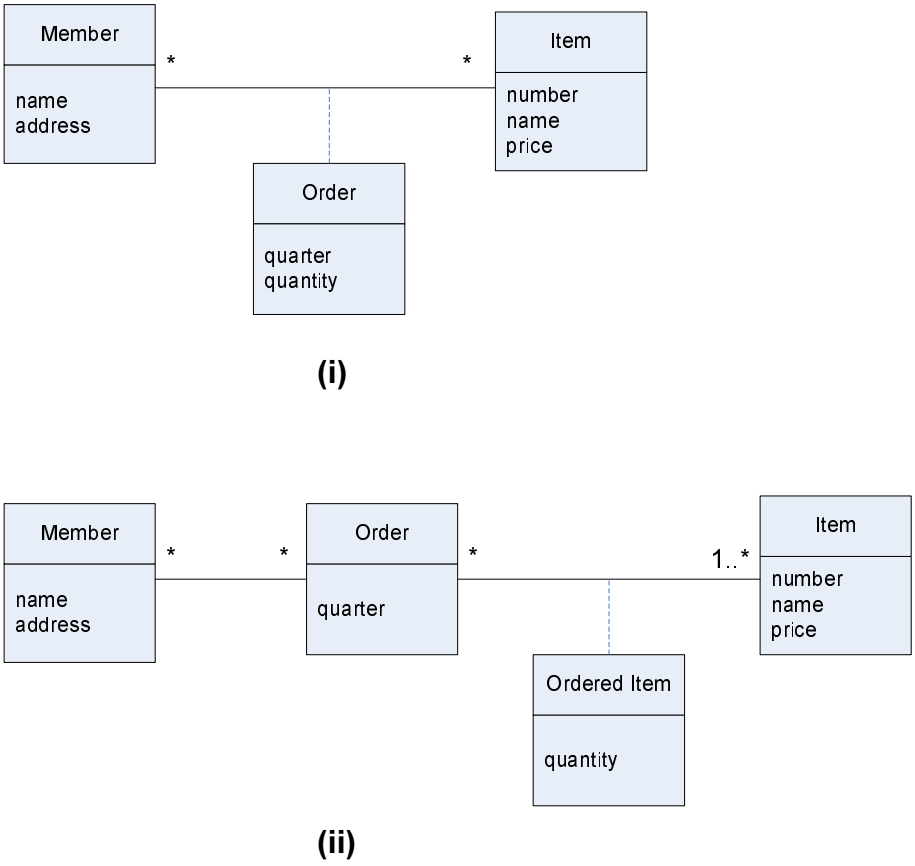

Figure 1: Two ERDs.

(d) How many members are related to a given order in (i) and in (ii)? `In (i) an order is a pair (member, item), so a member per order. In (ii) there can be any number of members per order, including 0.`

(e) Figure **??** is a third ERD of the same subject domain. Add cardinality constraints to figure **??** so that: one member can order multiple items per order; place one or more orders per quarter. `See figure 2.`

3. Figure 3 shows a statechart of the controller of a robot that can carry items over a horizontal surface from loading station A to loading station B. Loading station B has a higher platform than A, so between A and B the robot must lift the item.

   (a) Make a context diagram that shows the communication between the controller and the robot.

   (b) In figure 3, moving is interleaved with lifting and lowering. The process can be speeded up if we make the robot lift and lower the item when it moves. Make a state chart that represents this as two parallel processes.

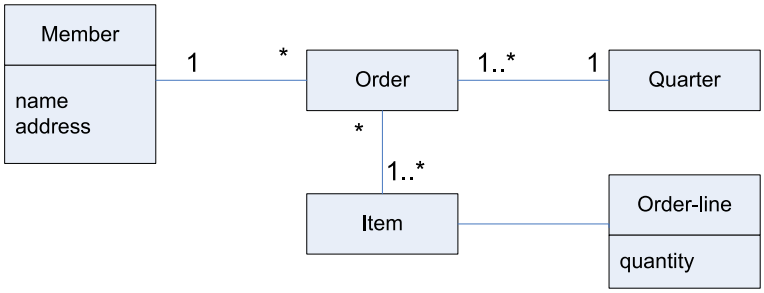

Figure 2: An ERD to which cardinality constraints needed to be added, to which the cardinality constraints have been added.

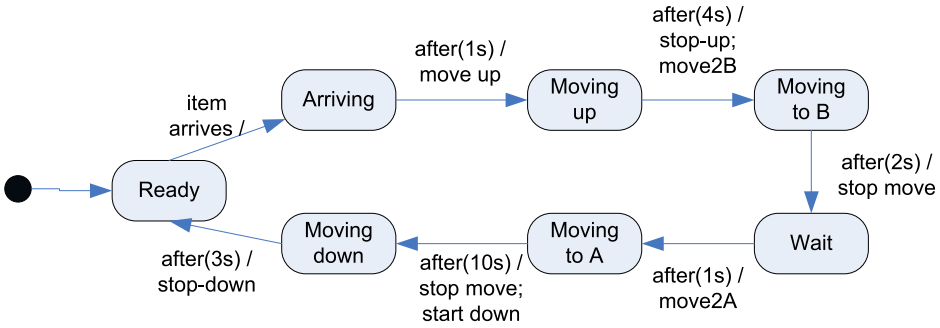

Figure 3: A statechart.

(c) Figure 3 assumes that the robot starts at station A, standing still with its carrying plate at the level of platform A. Change the process as follows: When switched on, the controller sends an initialize command to the robot, and then waits for a message *initialized* from the robot, to which it responds by displaying aa message *ready* on a screen and entering the READY state.

(d) The robot contains a big red button that, when hit, stops all movement immediately. Add an event emergency to the control process that leaves whatever state the robot is in and displays a message emergency stop on a screen.

4. (a) Consider a coffee machine. We can put in ground coffee and water and switch it on. When switched on, it heats the water and pours the heated water through the ground coffee so that coffee drips into a pot. We can take out the pot at any time to pour coffee from it. Classify the functional properties of the coffee machine into three classes: functions, behavior and communication. `Chapter 4 exercise 5.`

(b) A requirements-level architecture can be designed using the following guidelines:

G1 Functional decomposition

G2 Subject-oriented decomposition

G3 Event-oriented decomposition

G4 Device-oriented decomposition

G5 User-oriented decomposition

G6 Behavior-oriented decomposition

Explain each of these guidelines. `Pages 241 and further`

(c) A car consists of many parts. Classify each of the following components of a car according to the above guidelines. Is it a functional component, and/or a subject-oriented components, etc.? Explain your answer(s). (1) steering wheel `functional` (2) bumper `functional, device-oriented` (3) cruise control `behavior` (4) speed indicator display `subject-oriented`

(d) Communication in a data flow style architecture uses channel addressing, whereas communication in an object-oriented style architecture uses destination addressing. Explain what the difference is and describe their relative advantages. `pages 194, 238-239`

Problem	a	b	c	d	e	
1	4	6	4	4		18
2	4	4	6	4	6	24
3	4	6	6	6		22
4	6	6	8	6		26
						90

Grade = (10 + points)/10