# 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.

   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.

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

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

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?

   (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.

   (d) How many members are related to a given order in (i) and in (ii)?

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

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.
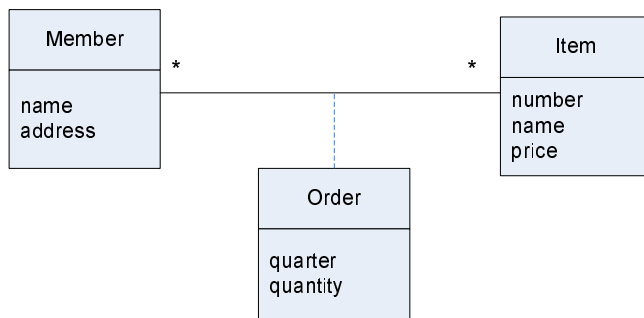
(i)
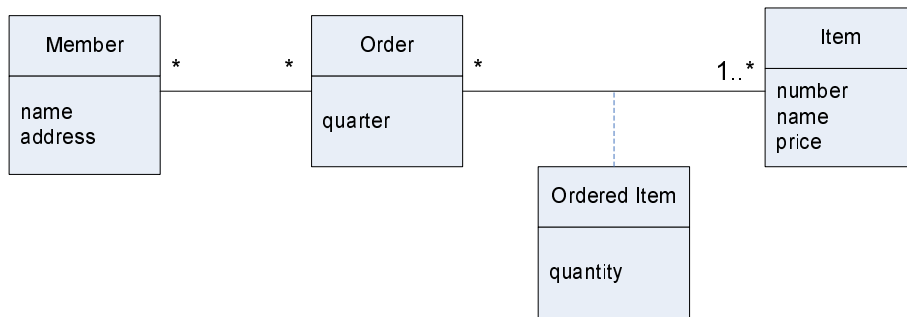
(ii)

Figure 1: Two ERDs.

(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.

(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
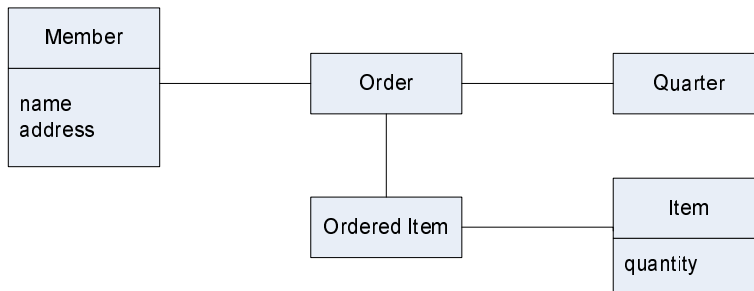
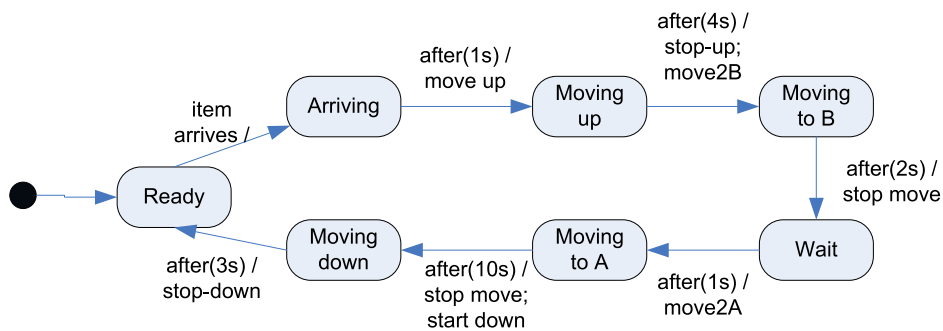Figure 2: An ERD to which cardinality constraints need to be added.

Figure 3: A statechart.

    it. Classify the functional properties of the coffee machine into three classes: functions, behavior and communication.

(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.

(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 (2) bumper (3) cruise control (4) speed indicator display

(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.

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