UNIVERSITI SAINS MALAYSIA

Semester II Examination
Academic Session 2009/2010

February/March 2010

EEE 523 – HARDWARE SOFTWARE CO-DESIGN

Time: 3 Hours

INSTRUCTION TO CANDIDATE:

Please ensure that this examination paper contains **FIVE (5)** printed pages and **FIVE (5)** questions before answering.

Answer **4** questions.

Distribution of marks for each question is stated accordingly.

All questions must be answered in English.

1. (a) StateCharts are a popular specification model for embedded systems. What are the most important extensions of the StateChart model in comparison to an ordinary finite state machine (FSM)?

(20 marks)

(b) What are the disadvantages of the StateChart formalism?

(10 marks)

(c) Given the StateChart in Figure 1. Draw the state space of the StateChart as a tree, which shows the hierarchy of states and denotes the state types (basic state, sequential states, and parallel states). Then compute the set of states for the hierarchical automata which is defined by the StateChart from Fig. 1.

(40 marks)

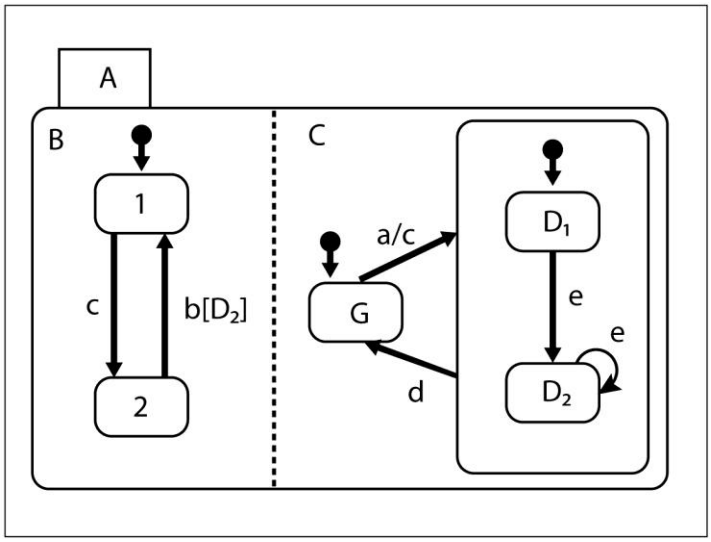

Figure 1 (StateChart)

(d) Draw a finite state machine which is equivalent to the StateChart from Fig. 1.

(30 marks)

2. The StateChart model of a simplified vending machine is shown in Figure 2.

(a) Describe the trace of transitions occurring when the user inserts a coin and orders tea.

(20 marks)

(b) The control of the vending machine has a bug that allows the user to cheat. Describe the trace of transitions that illustrate the bug.

(30 marks)

(c) Draw the corresponding StateChart that fixes the bug.

(50 marks)

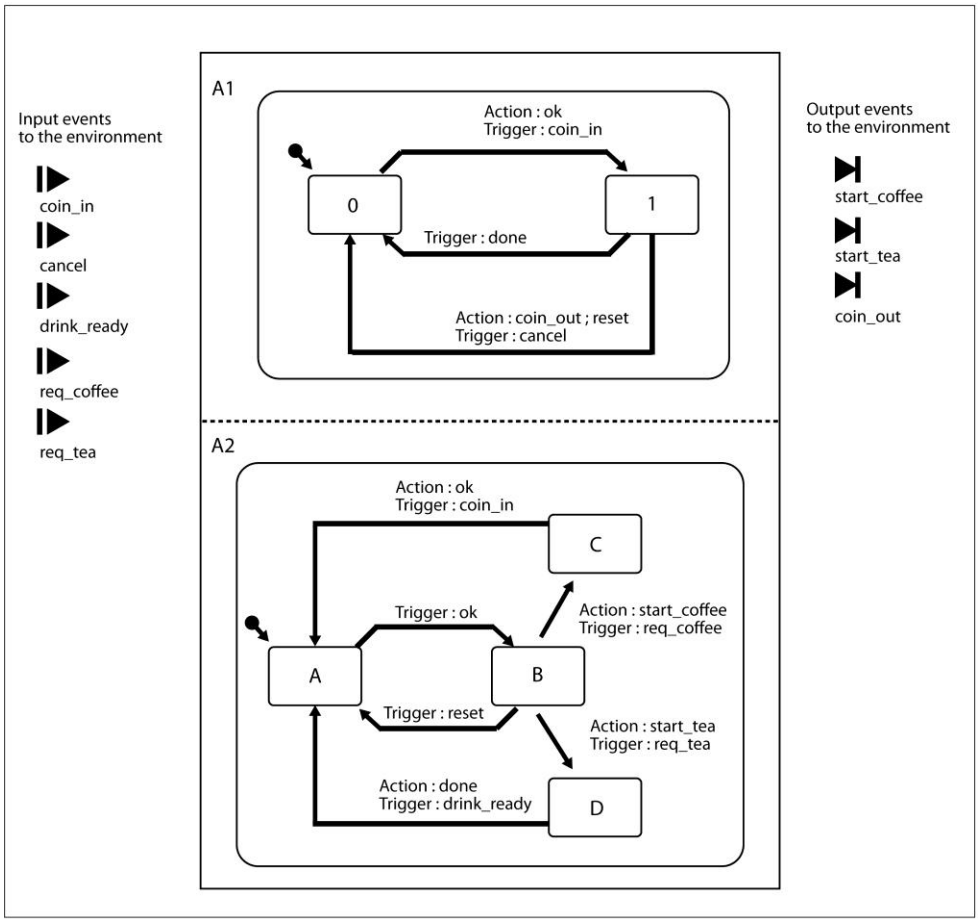

Figure 2

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3. (a) Describe Kahn Process Network model of computation and highlight some of the favorable characteristics of KPN.

(30 marks)

(b) Draw a Kahn process network that can generate the sequence of quadratic numbers n(n + 1)/2. Use basic processes that add two numbers, multiply two numbers, or duplicate a number. You can also use initialization processes that generate a constant and then simply forward their input. Finally, you can use a sink process.

(70 marks)

4. Given the SDF shown in Fig 3 below:

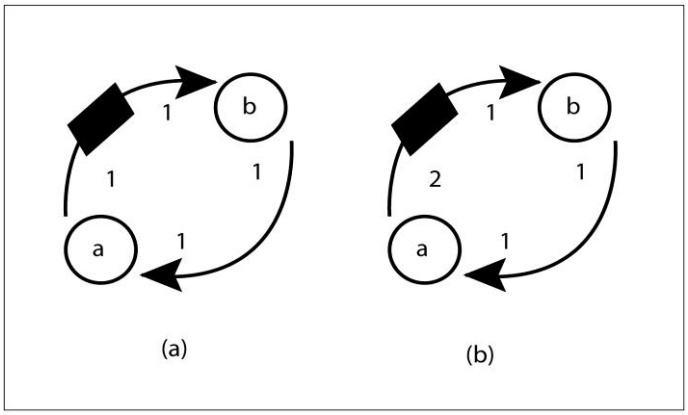

Figure 3

(a) Determine the topological matrix of these two SDF graphs. A topological matrix for q-node SDF Q=(n1, n2, …, nq) is a qxq matrix such that MxQ = 0 defines the flow constraints related to the DF arcs.

(25 marks)

(b) Are these two graphs consistent? A graph is consistent if MxQ = 0 has a solotion. A connected SDF graph with n nodes has a schedule iff its topology matrix M has rank n-1.

(25 marks)

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(c) For the graph shown in Fig 4 below, determine its topology matrix and determine if it is consistent. Find a solution to determine the relative number of node firings for a periodic schedule.

(50 marks)

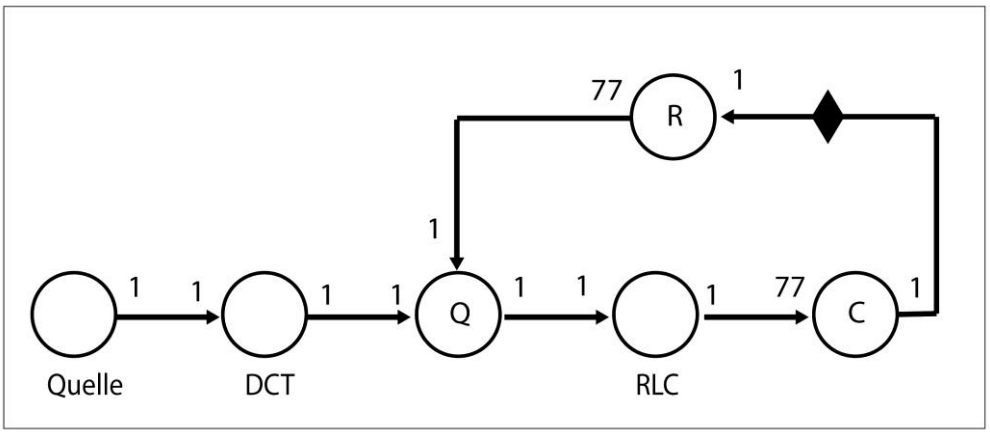

Figure 4

5. (a) With the help of relevant illustrations, differentiate between discrete time-driven simulation and event-driven simulation.

(25 marks)

(b) Describe the following components of a Discrete-Event Simulation

(i). Simulation Clock

(ii). Event list

(iii). Subsystem modules

(30 marks)

(c) Using a flowchart describe the Discrete-Event Simulation Engine.

(45 marks)

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