Ch 4

Minia University
Faculty of Engineering
Computers and Systems Eng. Dept.
May, 2020

Course Code: CSE422
Course Title: Computer Controlled Systems
Time Allowed: 3 hrs.
Total Marks: 120

This exam consists of 4 questions located in 2 pages. Attempt all the questions and assume any missing data or logical assumptions.

Question (1): (30 marks)

1. Define the following concepts:
   a. Machine-to-Machine (M2M). *(5 marks)*
   b. Industry 4.0. *(5 marks)*
2. The following two figures represent a finite state machine (FSM) for a traffic light system. Fig. represents the subsystem of car traffic light, while Fig. describes pedestrian traffic light. Answer the following questions:

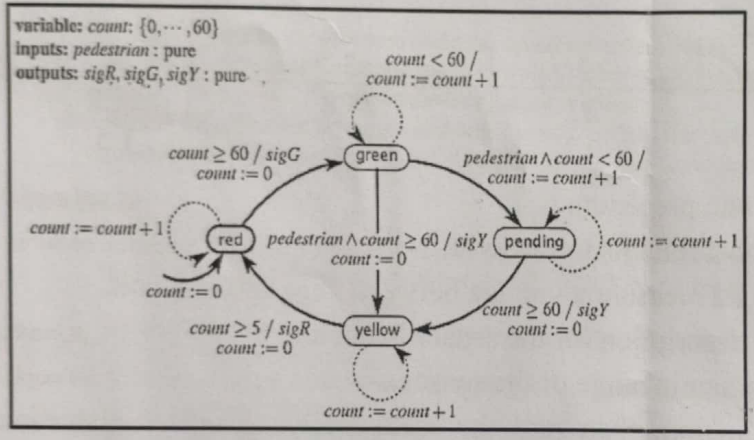

Fig. 1 Car Traffic Light FSM

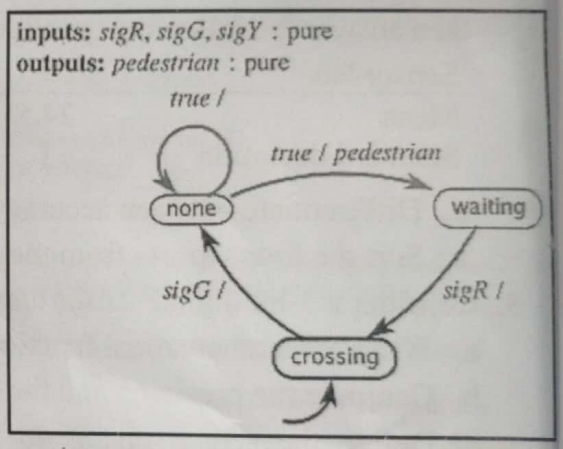

Fig. 2 Pedestrian Traffic Light FSM

   a. Define the following concepts related to FSM: Determinacy, and reachable states. *(4 marks)*
   b. What is the determinacy for both FSM in Fig. and Fig. 2. *(2 marks)*
   c. For the car traffic light FSM in Fig. 1, determine the size of state space, and the number of reachable states. *(4 marks)*
   d. Write the mathematical model for the pedestrian traffic light FSM on Fig. 2. *(10 marks)*

Question (2): (30 marks)

1. Explain the concept of model of computations (MoC). *(10 marks)*
2. Consider the following synchronous dataflow (SDF) model in Fig. 3 and answer the following questions:
   a. Define: Synchronous dataflow model. *(4 marks)*

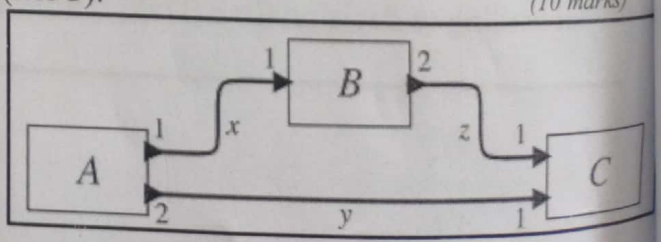

Fig. 3 An SDF model

b. Related to buffering in dataflow models, explain the issues of unbounded execution, and deadlock. *(4 marks)*

c. For the network in Fig. 3, write the system of balance equations for the SDF model and describe it in a matrix form. *(4 marks)*

d. Obtain the least positive integer solution for the balance equations. *(4 marks)*

e. Give an example of a scheduling pattern for the network in Fig. 3 to get an unbounded execution with bounded buffers. *(4 marks)*

Question (3): (30 marks)

1. Design a timed automata model for heating, ventilation, and air conditioning (HVAC) system that regulates the room temperature at 20°C. *(10 marks)*
2. Assume you are testing four different types of temperature sensors by an experiment. The experiment is conducted by having 100 measurements of each sensor. The real temperature measured by a calibrated reliable sensor is $25°C$. Read the statistical analysis of the sensors then answer the following questions:

Sensor No.	1	2	3	4
Mean	24.5	22	24.8	21.9
Standard deviation	1	0.2	0.4	1.5

   a. Differentiate between accuracy and precision. *(4 marks)*

   b. Sort the four sensors from the most reliable to the least. *(4 marks)*

3. Consider a 3-bit digital sensor that can measure a voltage between zero and one volt.

   a. Write the mathematical function description for the sensor behavior. *(4 marks)*

   b. Compute the precision and the dynamic range of the sensors. *(4 marks)*

   c. Define the sensor distortion function, then plot the ideal staircase sensor distortion function for this sensor. *(4 marks)*

Question (4): (30 marks)

1. Define the concept of memory model? *(6 marks)*
2. What is meant by garbage collection in memory? Explain why it is prohibited in some standards and coding guidelines like MISRA-C. *(6 marks)*
3. Explain the three abstraction layers for concurrency. *(8 marks)*
4. Define the concept of scheduling decisions, then compare different types of schedulers according to decision time (Design time or run time). *(10 marks)*

With my best wishes,
Dr. Ahmed Mahmoud