

Syllabus Content:

4.2 Algorithm design methods

4.2.3 State-transition diagrams



use state-transition diagrams to document an algorithm

use state-transition diagrams to show the behaviour of an object

4.2.3: State- transition diagrams:

A computer system can be seen as a finite state machine (FSM). An FSM has a start state. An input to the FSM produces a transformation from one state to another state.




The information about the states of an FSM can be presented in a state-transition table.

KEY TERMS

Finite state machine (FSM): a machine that consists of a fixed set of possible states with a set of inputs that change the state and a set of possible outputs


State-transition table: a table that gives information about the states of an FSM

Table shows an example FSM represented as a state-transition table. If the FSM is in state S1, an input of a causes no change of state.

-  If the FSM is in state S1, an input of b transforms S1 to S2.
-  If the FSM is in state S2, an input of b causes no change of state.
-  If the FSM is in state S2, an input of a transforms S2 to S1.

		current state	
		S1	S2
input	a	S1	S1
	b	S2	S2

A state-transition diagram can be used to describe the behaviour of Table 24.05 State-transition table an FSM.

Figure STD shows the start state as S1 (denoted by ). If the FSM has a final state (also known as the halting state), this is shown by a double-circled state (S1 in the example).

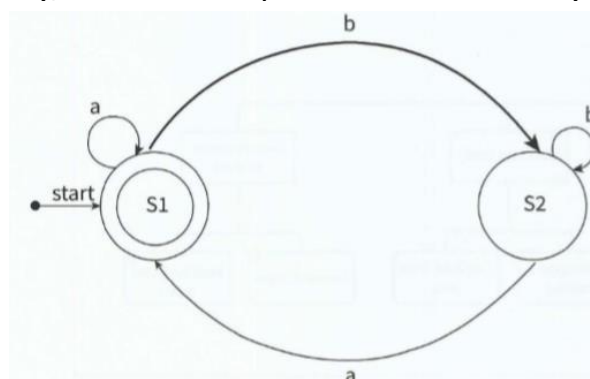


Figure STD

If an input causes an output this is shown by a vertical bar, For example, if the current state is S1, an input of b produces output c and transforms the FSM to state S2.

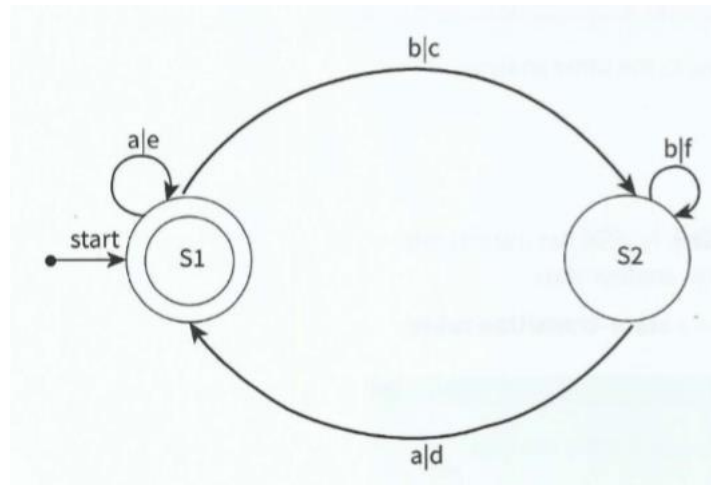


Figure State-transition diagram with outputs

Creating a state-transition diagram for an intruder detection system

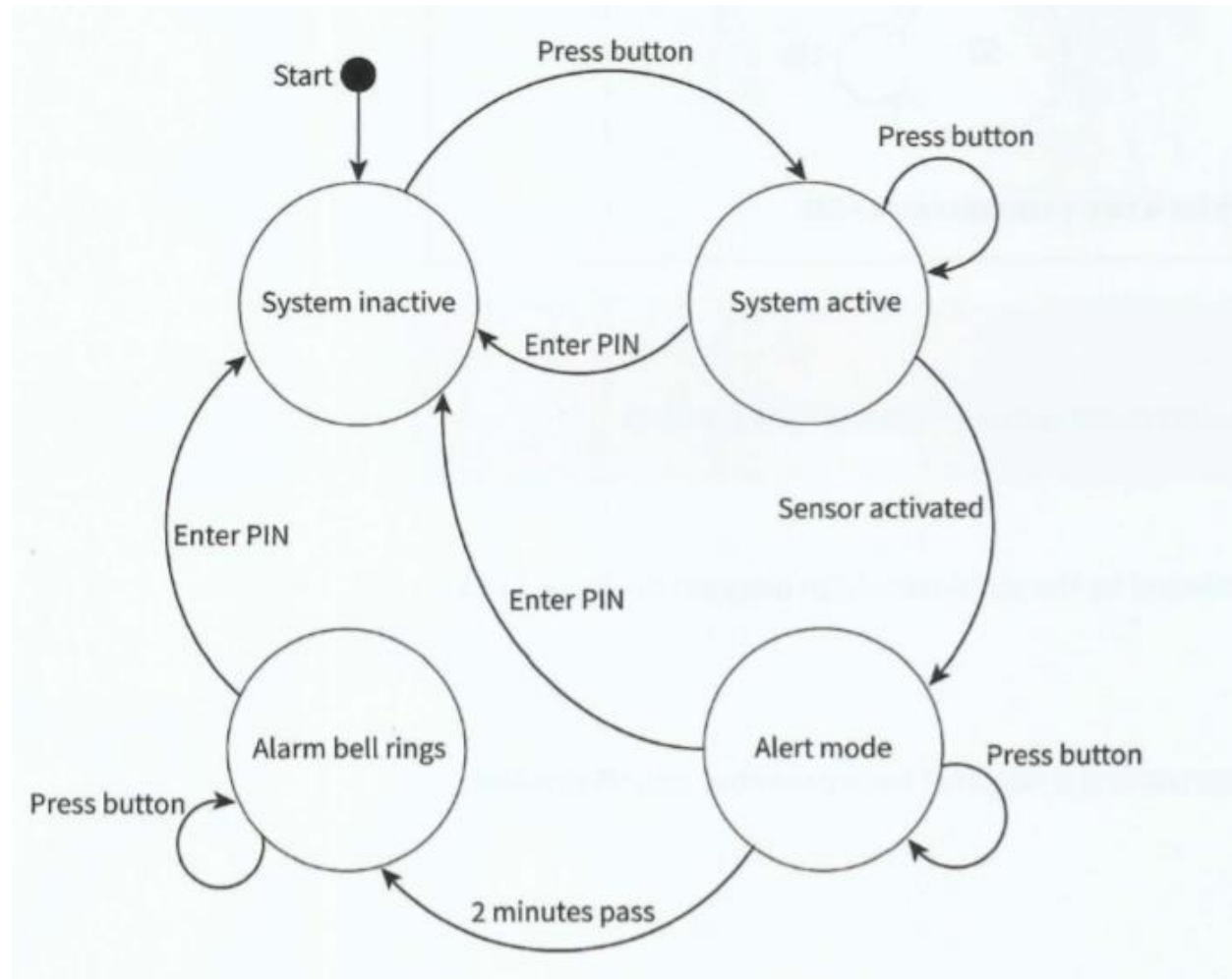
A program is required that simulates the behaviour of an intruder detection system.

Description of the system: The system has a battery power supply. The system is activated when the start button is pressed. Pressing the start button when the system is active has no effect. To de-activate the system, the operator must enter a PIN. The system goes into alert mode when a sensor is activated. The system will stay in alert mode for two minutes. If the system has not been de-activated within two minutes an alarm bell will ring.

We can complete a state-transition table (Table) using the information from the system description.

Current state	Event	Next state
System inactive	Press start button	System active
System active	Enter PIN	System inactive
System active	Activate sensor	Alert mode
System active	Press start button	System active
Alert mode	Enter PIN	System inactive
Alert mode	2 minutes pass	Alarm bell ringing
Alert mode	Press start button	Alert mode
Alarm bell ringing	Enter PIN	System inactive
Alarm bell ringing	Press start button	Alarm bell ringing

The start state is 'System inactive'. We can draw a state-transition diagram (Figure 24.07) from the information in Table



Past Paper Questions:
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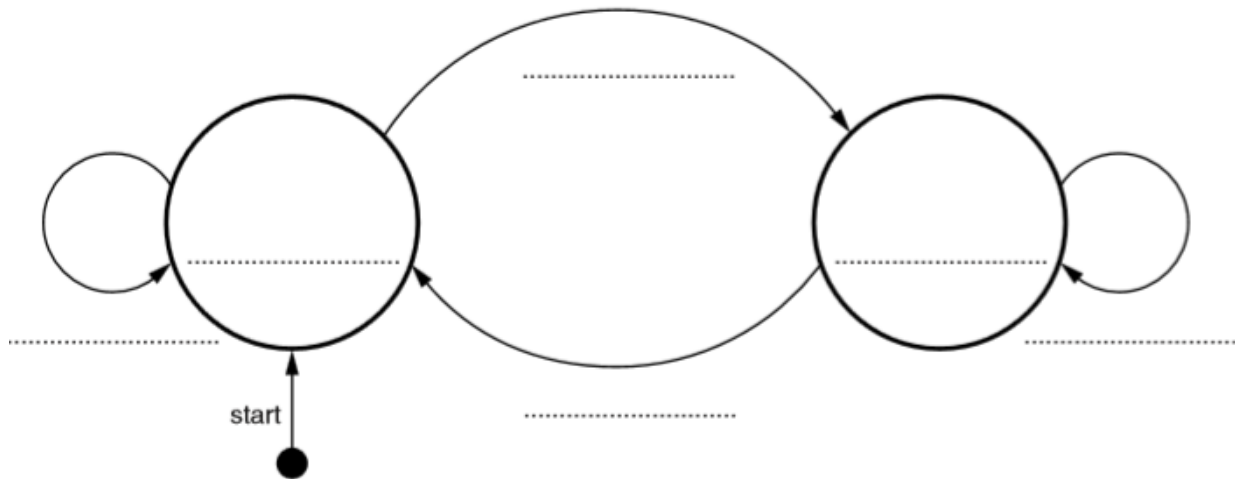
1/- A turnstile is a gate which is in a locked state. To open it and pass through, a customer inserts a coin into a slot on the turnstile. The turnstile then unlocks and allows the customer to push the turnstile and pass through the gate.

After the customer has passed through, the turnstile locks again. If a customer pushes the turnstile while it is in the locked state, it will remain locked until another coin is inserted.

The turnstile has two possible states: **locked** and **unlocked**. The transition from one state to another is as shown in the table below.

Current state	Event	Next state
Locked	Insert coin	Unlocked
Locked	Push	Locked
Unlocked	Attempt to insert coin	Unlocked
Unlocked	Pass through	Locked

Complete the state transition diagram for the turnstile:



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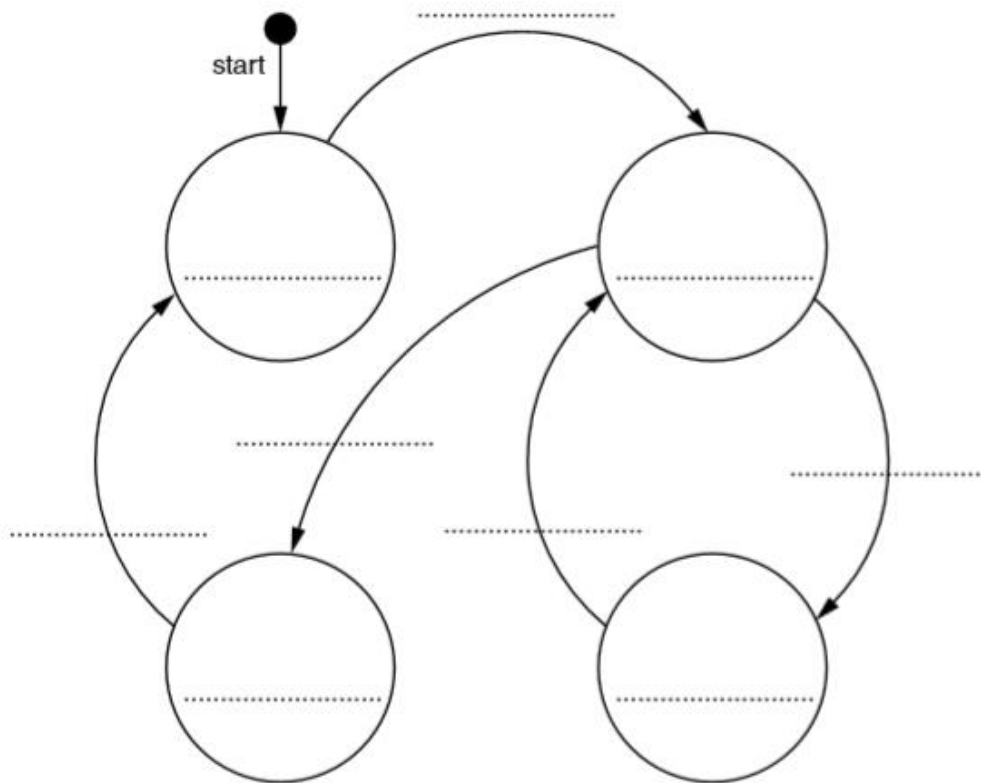
Q2/ - A petrol filling station has a single self-service petrol pump.

A customer can use the petrol pump when it is ready to dispense petrol. The pump is in use when the customer takes the nozzle from a holster on the pump. The pump dispenses petrol while the customer presses the trigger on the nozzle. When the customer replaces the nozzle into the holster, the pump is out of use. The cashier must press a reset button to make the pump ready for the next customer to use.

The petrol pump's four possible states and the transition from one state to another are as shown in the table below.

Current state	Event	Next state
Pump ready	Take nozzle	Pump in use
Pump in use	Press trigger	Pump dispensing
Pump dispensing	Stop pressing trigger	Pump in use
Pump in use	Replace nozzle	Pump out of use
Pump out of use	Reset pump display	Pump ready

Complete the state transition diagram for the petrol pump:

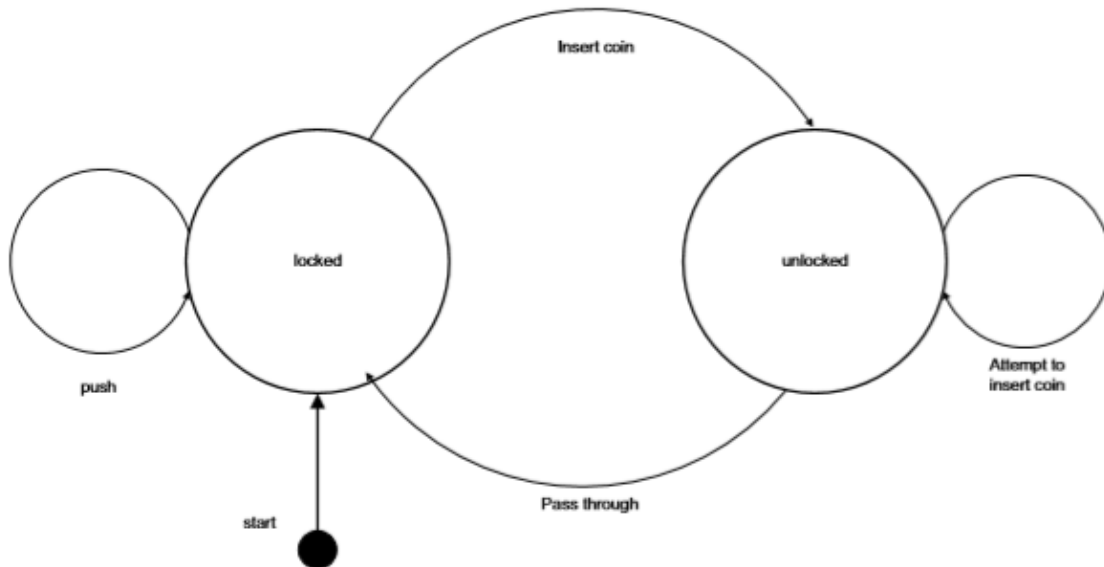


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Answers

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1



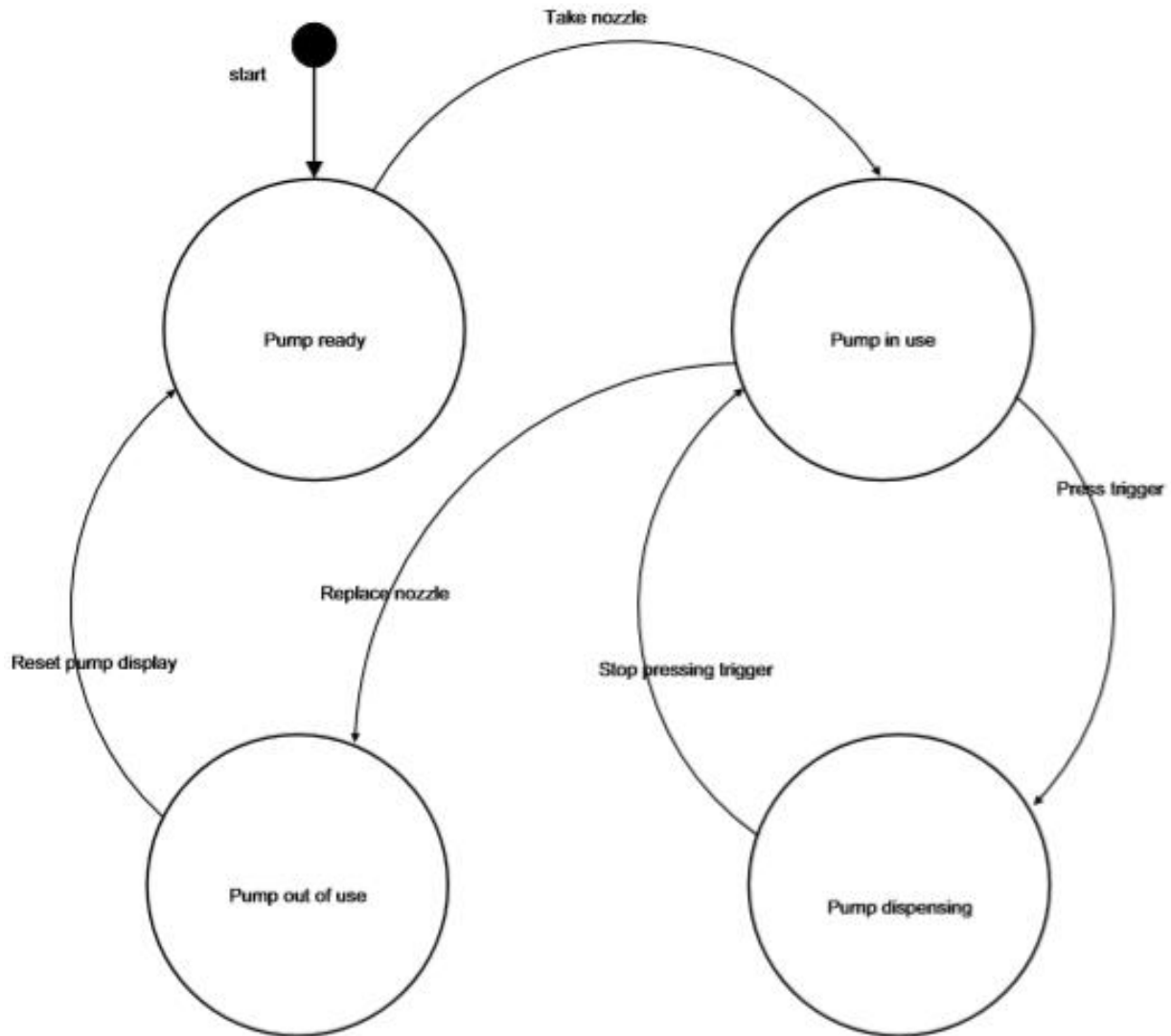
Mark as follows:
1 mark for both states correct
1 mark for each further label

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References:

- AS & A level Course Book by Sylvia Langfield & Dave Duddell
- A level 9608 Pastpapers