# Object Oriented Analysis and Design: Assignment 8
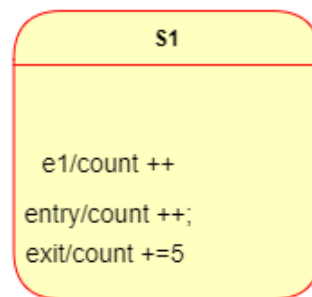
Total Marks : 20

September 7, 2022

## Question 1

Consider a small part of a state diagram in the following. Suppose that the object is in the state S1 and the value of $count = 0$.

*Marks: 2* **MCQ**



Identify the value of the *count* if the internal event e1 is triggered.

a) 1

b) 6

c) 7

d) 2
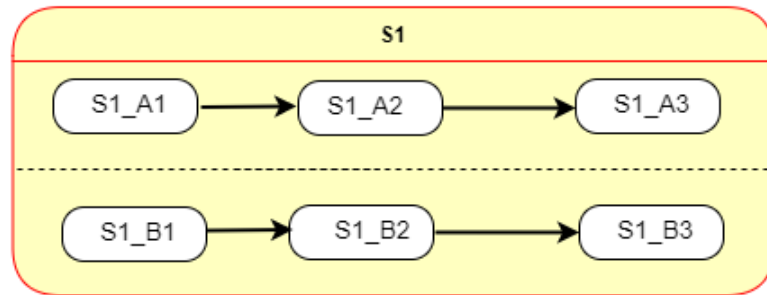
**Answer**: a)
**Explanation:** As e1 is an internal event, it will remain in the same state and the entry and exit actions are not going to take place.
Hence, option (a) is the correct option.

# Question 2

Consider a composite state as shown below.



Suppose that a state machine diagram is to be built without using any composite state. How many simple states at the least and at the most (respectively) may be required to model the given composite state?
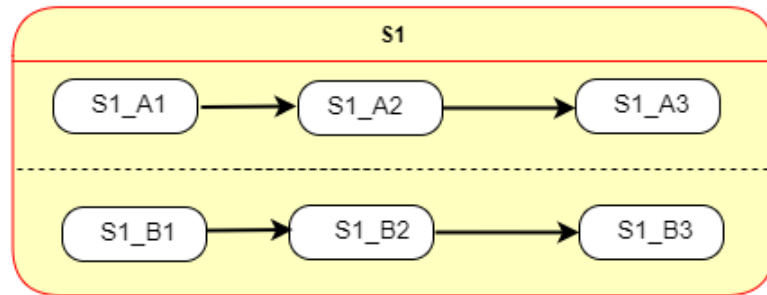
*Marks: 2* **MCQ**

a) 6, 6

b) 6, 8

c) 6, 9

d) 3, 6

**Answer**: c)

**Explanation:** A `simple state` is a state that does not have any substates. In the given orthogonal composite state, each pair of states from the two regions is a possible simple state (if each substate in one region is completely dependent on another substate in the other region). However, sometimes, if the sub states in the two regions are completely independent then, only all substates in two regions are adequate to model the composite state.

Hence, option (c) is the correct option.

# Question 3

Consider a composite state as shown below.



Identify the correct statement(s) from the following.

*Marks: 2* **MSQ**

a) If an object is in S1 state, it may be both in S1_A1 and in S1_A2 substates.

b) S1 is a simple composite state.

c) S1 is a orthognal composite state.

d) If an object is in S1 state, it may be both in S1_A1 and in S1_B1 substates.

**Answer**: (c), (d)
**Explanation:** A simple state is a state that does not have any substates. A Simple composite state contains just one region. An Orthogonal composite state has more than one region. Hence, option (c) is correct.
In one region, an object may be only in one of the substates.
Hence, options (c) and (d) are correct.

# Question 4

Identify the correct option(s) about the clipping of a `behavioral state machine diagram` given below. *Marks: 2* **MCQ**
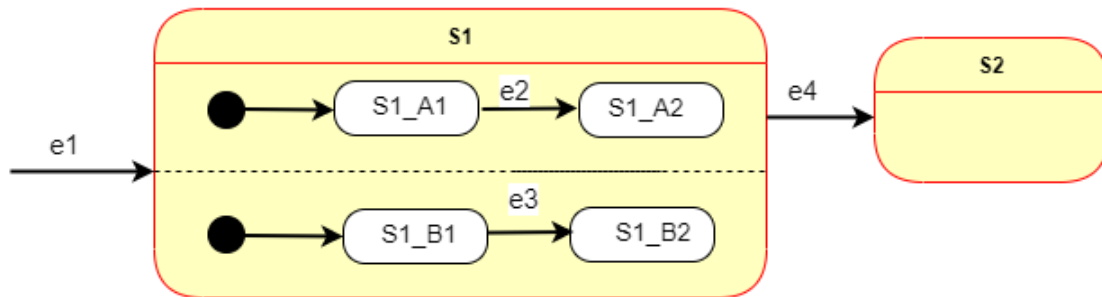


a) If an event `e1` occurs, the active states may be either `S1_A1` or `S1_A2` and `S1_B1` or `S1_B2`.

b) While inside the state `S1`, if an event `e4` occurs, state change will occur irrespective of the current active substates of the object.

c) While inside the state `S1`, if an event `e4` occurs, the active state must be `S1_A2` or `S1_B2` before state transition takes place.

d) While inside the state `S1`, if an event `e4` occurs, the active state must be `S1_A2` and `S1_B2` before state transition takes place.
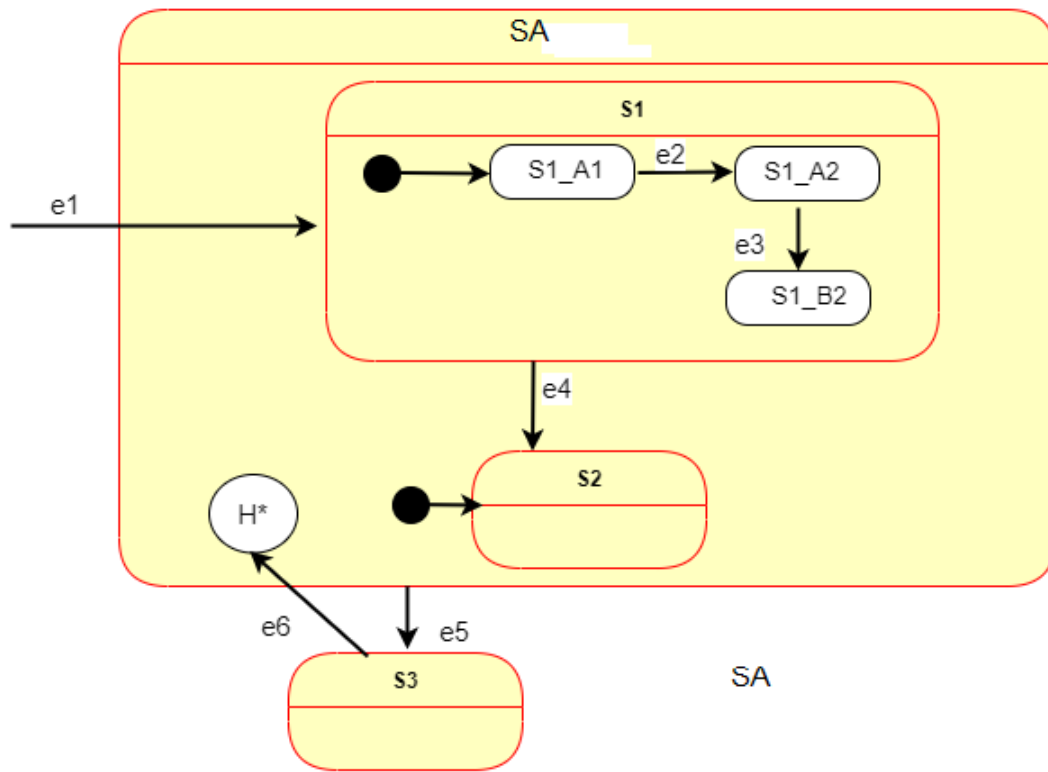
**Answer**: b)

**Explanation:** If an event `e1` occurs, the active states must be `S1_A1` and `S1_B1`. Hence, option (a) is incorrect.

While inside the state `S1`, if an event `e4` occurs, state change will occur irrespective of the current active substates of the object because the event is drawn from the boundary of the superstate.

Hence, option (b) is correct.

# Question 5

Consider the following clipping of a `behavioral state machine diagram`.



Suppose, the current state is `S1_A2`. Events `e5`, and `e6` are triggered. What will be the next active state?

*Marks: 2* **MCQ**

a) `S1_A2`

b) `S1_A1`

c) Either `S1_A1` or `S1_A2` or `S2`

d) `S2`

**Answer**: a)
**Explanation:** According to the semantics of deep history state, Option (a) is correct.

# Question 6

Consider the following clipping of a `behavioral state machine diagram`.



Suppose, the current state is `S1_A2`. Events `e5`, and `e6` are triggered. What will be the next active state?
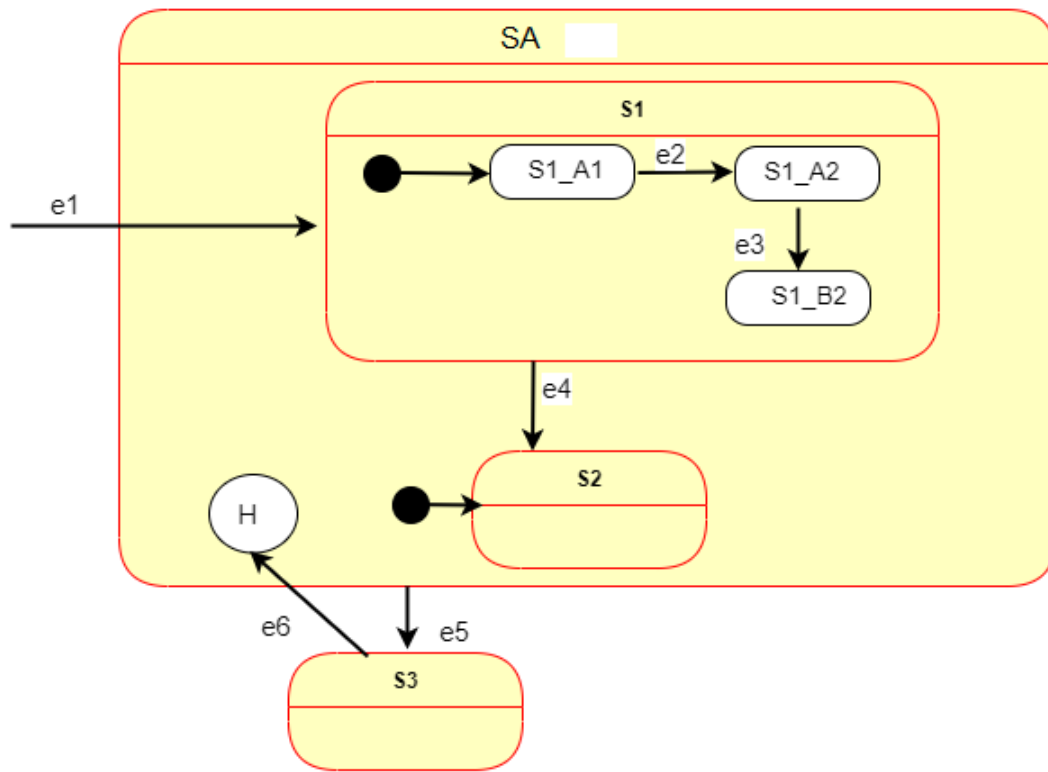
*Marks: 2* **MCQ**

a) `S1_A2`

b) `S1_A1`
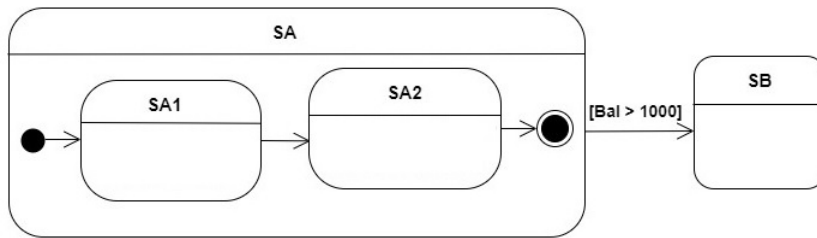
c) Either `S1_A1` or `S1_A2` or `S2`

d) `S2`

**Answer**: d)
**Explanation:** According to the semantics of shallow history state, Option (d) is correct.

# Question 7

Consider the following `statechart diagrams` shown below.               *Marks: 2* **MCQ**



Identify the correct option(s) for which the `transition` takes place to the `state SB`.

a) As early as the `guard condition (Bal>1000)` is evaluated to true.

b) As early as the `event (Bal>1000)` occurs.

c) If the system arrived at the `final state of SA2` and at that time if the `guard condition(Bal>1000)` is true.

d) As early as all `activities` within `state SA1` are completed and the `guard condition(Bal>1000)` is true.

**Answer**: c)
**Explanation:** `State SA` is a `composite state`. The system arrived to the `substate SA2` then reached to the final state and at that moment if `guard condition (Bal>1000)` is true then only `transition` can happen to the state SB.
Hence, option (c) is the answer.

Questions 8 to 10 are based on the following passage and the three tables.

A heating-cooling machine starts in idle mode, showing the temperature. (The method "showTemp()" is called to show the current temperature.)

If the temperature is more than 26 degrees, the heater enters into cooling mode. In this mode, after calling the method "start_up', the system automatically gets initialized. Once started, the system goes to ready state after calling a method "start_ compressor". From the ready state, the system goes to running state after switching on the fan by calling a method "start_fan". Once the temperature becomes 24 degrees, the system goes back to idle state. Before exitting from cooling mode, the system calls "shut_down" method. In case of a break down while cooling, the system goes to failure state.

When the system enters into the failure state, it starts an alarm by calling "start_alarm()" method. In this state, the system continuously flashes a red light by calling "flash_light" method. When the system comes out from failure state after the system is repaired, it stops the red light flash by calling a method "stop_flashing" method.

When the system is in idle mode, if the temperature goes below 22 degrees, the systems automatically goes to a heating mode. After entering into this mode, "start_up" method is called. Inside the heating mode, the system blows hot air by calling "blow_hot_air" method. Finally before exiting this state, the system shuts down the heater by calling "shut_down" method. When the system is in heating mode, failure may occur and the system, then, goes to failure state as discussed. When the temperature becomes 25 degrees, the system returns to idle state.

Suppose that a statechart diagram has been drawn to model the life of a heating-cooling machine with the following (simple or composite) states: `Idle`, `Heating`, and `Cooling` and `Failure`. For composite states, other necessary substates are also created.

| Sl. No. | Guard |
|---------|-------|
| 1 | when(temp > 26) |
| 2 | when(temp = 24) |
| 3 | when(temp = 22) |
| 4 | when(break_down=true) |
| 5 | when(repaired=true) |

(a) Events

| Sl. No. | Action |
|---------|--------|
| 1 | start_up() |
| 2 | start_compressor() |
| 3 | start_fan() |
| 4 | start_alarm() |
| 5 | stop_flashing() |
| 6 | flash_light() |
| 7 | shut_down() |
| 8 | blow_hot_air() |
| 9 | showTemp() |

(b) Actions

A transition from a state `s1` to `s2` can be denoted by a:2; b:3. This means that from the state `s1` to the state `s2`, the transition is:
`when(temp = 24) / start_fan().`
a:2 indicates that the event is the entry in the second row in the Table (a).
b:3 indicates that the action is the entry in the third row in the Table (b).

In some transitions, the action part may not be present.

# Question 8

Identify the correct statement from the following. *Marks: 2* **MSQ**

a) All transitions are change events or automatic.

b) The state `Cooling` is a simple composite state having 4 substates.

c) The states `Cooling` is a orthogonal composite states with at least 3 substates.

d) The states `Cooling` is a simple composite state with 3 substates but `Idle` is a simple state.

**Answer**: a), d)
**Explanation:** Change events are denoted by `when` keyword. Hence, (a) is correct.
According to the description, the state `Cooling` has three disjoint substates: `initialized`, `ready`, and `running`.
Hence, options (a) and (d) are correct.

# Question 9

Match entries in the column A of the following table with the related entries in column B

| Sl. No. | Column A | Sl. No. | Column B |
|---|---|---|---|
| 1. | do action of the state Idle | a) | b6 |
| 2. | do action of the state Failure | b) | b2 |
| 3. | do action of the state Heating | c) | b9 |
| | | d) | b8 |

*Marks: 2* **MCQ**

a) 1-c, 2-a, 3-b

b) 1-c, 2-b, 3-d

c) 1-c, 2-a, 3-d

d) 1-b, 2-c, 3-d

**Answer**: c)
**Explanation:** According to the description, option (c) is correct.

# Question 10

Identify the correct statement(s).

a) The transition a4 comes out from the boundary of `Cooling` state.

b) The transition that changes the state from `Idle` state to `Cooling` is a1

c) The transition a4 comes out from the boundary of `Running` state.

d) The `exit` action of both `Failure` and `Heating` is b7

**Answer**: a), b)
**Explanation:** According to the statechart diagram, options (a) and (b) are correct.