CHAPTER 6

STATE DIAGRAM

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OBJECT-ORIENTED ANALYSIS AND DESIGN USING UML

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STATE DIAGRAM

❑ Difference between Statechart diagrams and Activity diagrams:

▪ **Activity diagram** are used to model how different areas of work behave with each other and interact

▪ **State diagrams** are used to represent a single object and how its behaviour causes it to change state (i.e., dynamic view of an object)

❑ a State diagram is composed by three components:

       (1) **state**

       (2) **transitions**

       (3) **events**

WHAT IS STATE?

❑ **State** is defined as a snapshot or a milestone of an object's behavior at a particular point in time

❑ A state represents a time period in the life of an object during which the object satisfies some condition, performs some action or waits for an event

Computer

Can be in the following states:
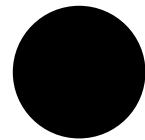
on

booting
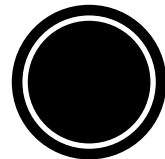
processing

idle

Shutting down

off

COMPONENTS - STATE

❑ There are three separate notations for state in the Statechart diagram:
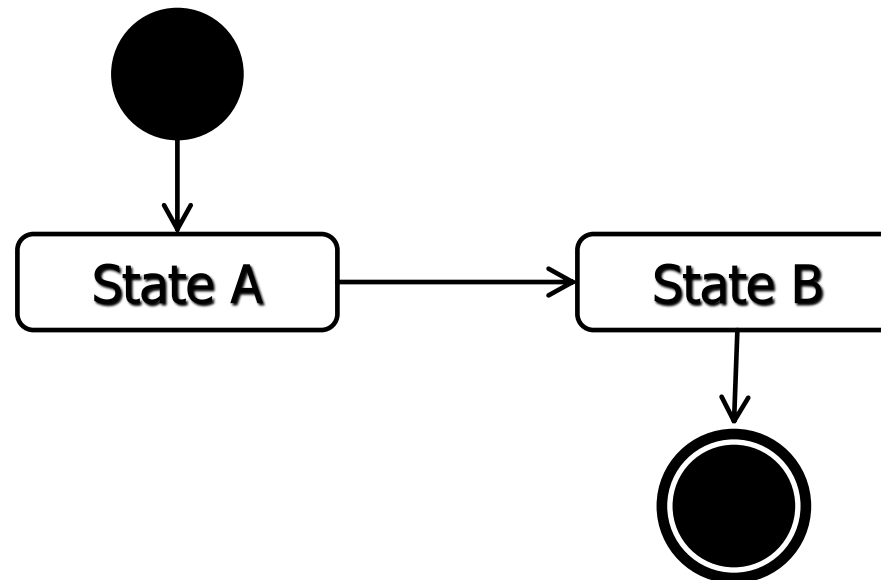
State   State

Start State

End State

COMPONENTS - TRANSITIONS

❑ Transitions are used to show flow from one state to another

❑ Transition of an object from a state to another cannot be paused in between

❑ A transition is a progression from one state to another and will be triggered by an event

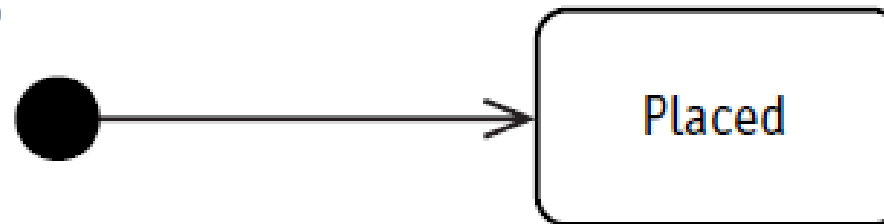❑ a State chart diagram can include more than one start/end states
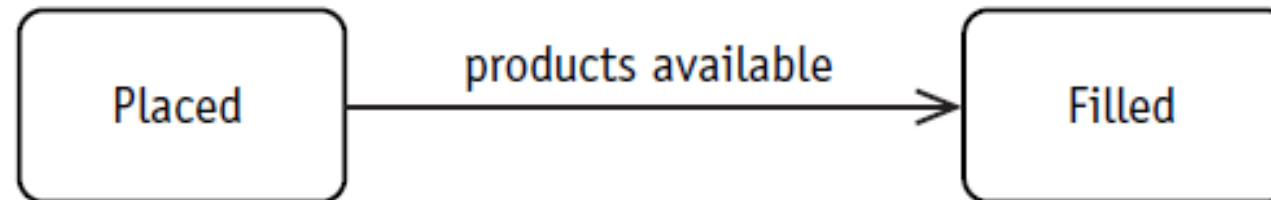
STATE, INITIAL STATE, TRANSITION

- State:

  Filled

- Initial State: The initial state indicates the state in which an object is

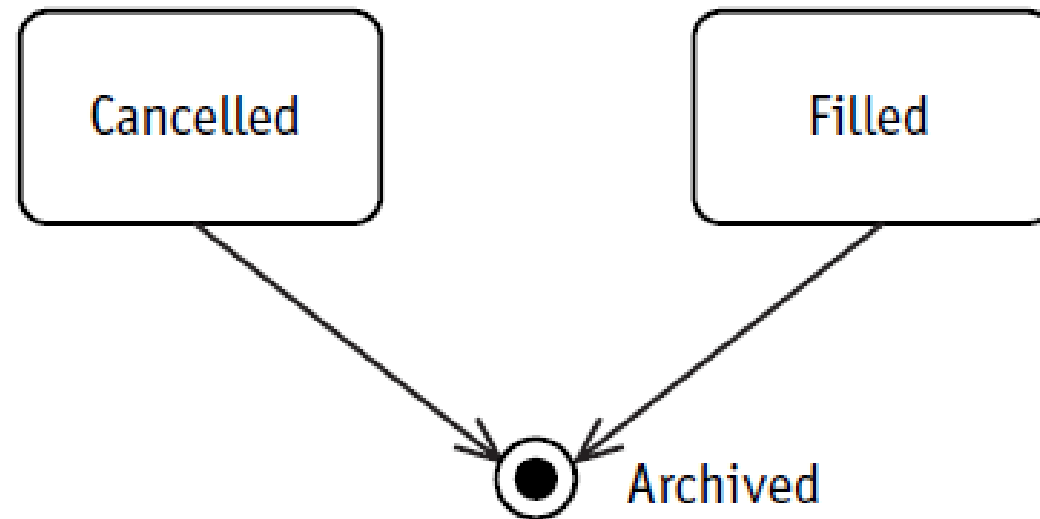 ⬤ ————→ Placed

- Transition:

  Placed ——products available——→ Filled

FINAL STATE

- An object may reach a *final* state from which it may not return to an active state. In other words, you would never see an arrow going out of this state. You may still see it and it may still exist, but you can no longer alter its state. The final state may also mean that the object has actually been deleted.

COMPONENTS – DECISION POINTS

❑ Decision points make the diagram more visually appealing by grouping transitions
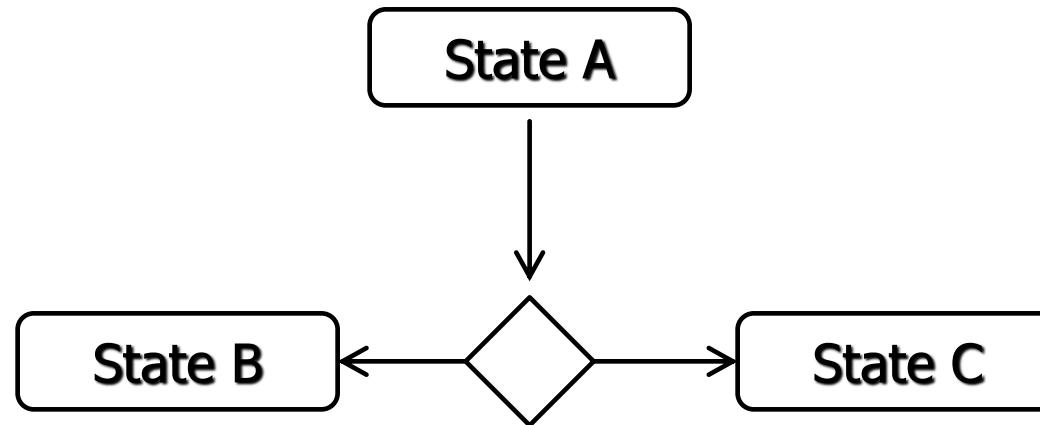
Take the decision of moving to state B or State C

COMPONENTS – SYNCHRONIZATION

❑ Synchronization bars are used to show were states need to catch up with or wait up for other to join

❑ States can have sub-states and may nested into another state
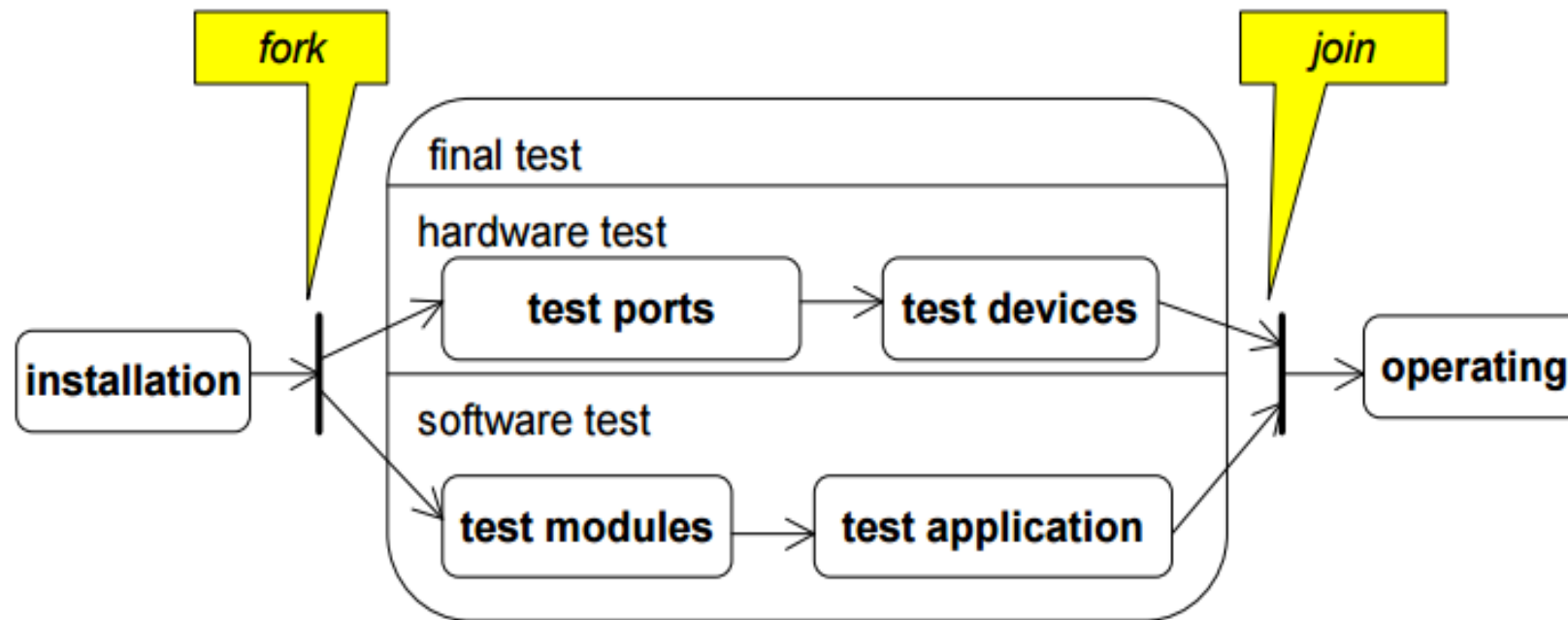
COMPONENTS – EVENT

- Events are indicated directly on the path of a transition from a state to another state

- An event is a "happening" that the system needs to know about,
  e.g. completing an assignment, passing an exam, system crash.

- An event may trigger an action by an actor or the system being developed

EVENT / ACTION

- Event: The reason of Transition

- Action: An action is associated with an event. An action is the behavior that is triggered by the event and it is the behavior that actually changes the attributes that define the state of the object. An action is an atomic task, and as such it cannot be broken into component tasks, nor can it be interrupted. There are no break points within it and, furthermore, stopping it midway would leave the object state undefined.

COMPONENTS – EVENT

- **Change events** occur when a condition becomes true, e.g., when(balance <= 1000)

- **Call events** indicate the receipt of a call for an operation (e.g., call autopilot)

```
┌──────────┐                 startAutopilot              ┌──────────┐
│ Manual   │ ──────────────────────────────────────────▶ │ Automatic │
│ control  │                                              │ control   │
└──────────┘                                              └──────────┘
```
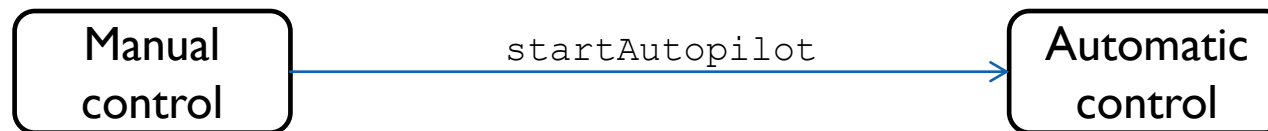
- **Time events** mark the designated period of time, e.g., after(10 seconds)

ENTRY ACTIONS
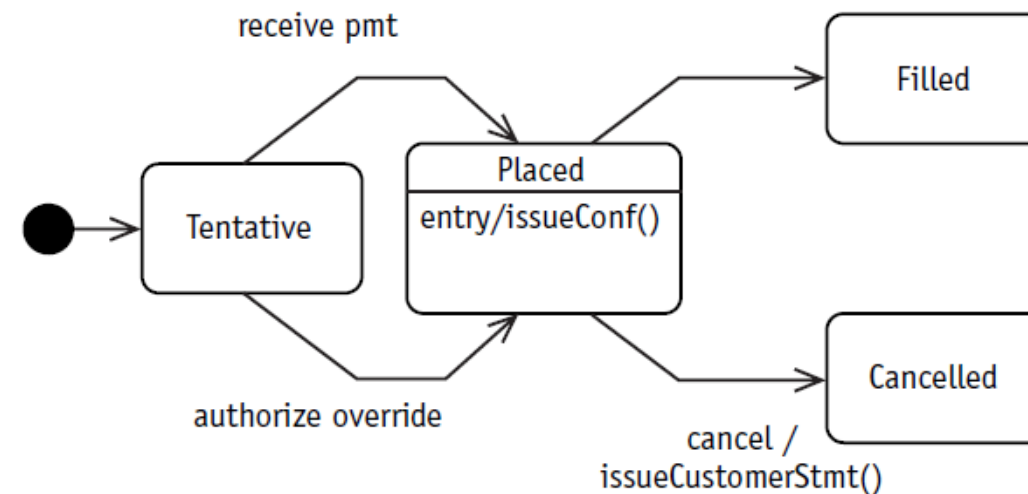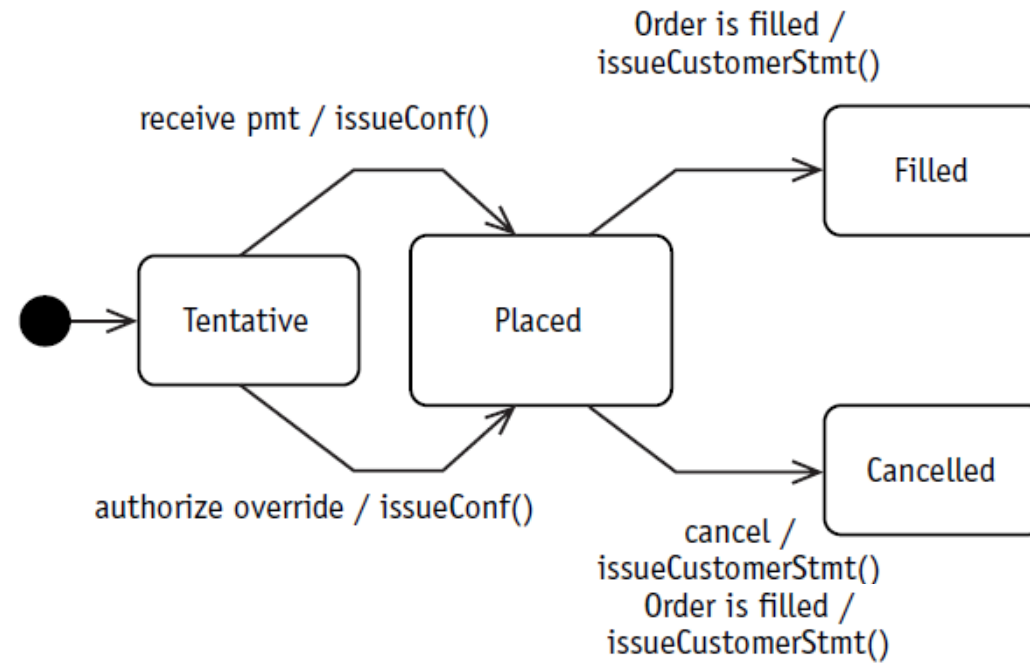
EXIT ACTIONS
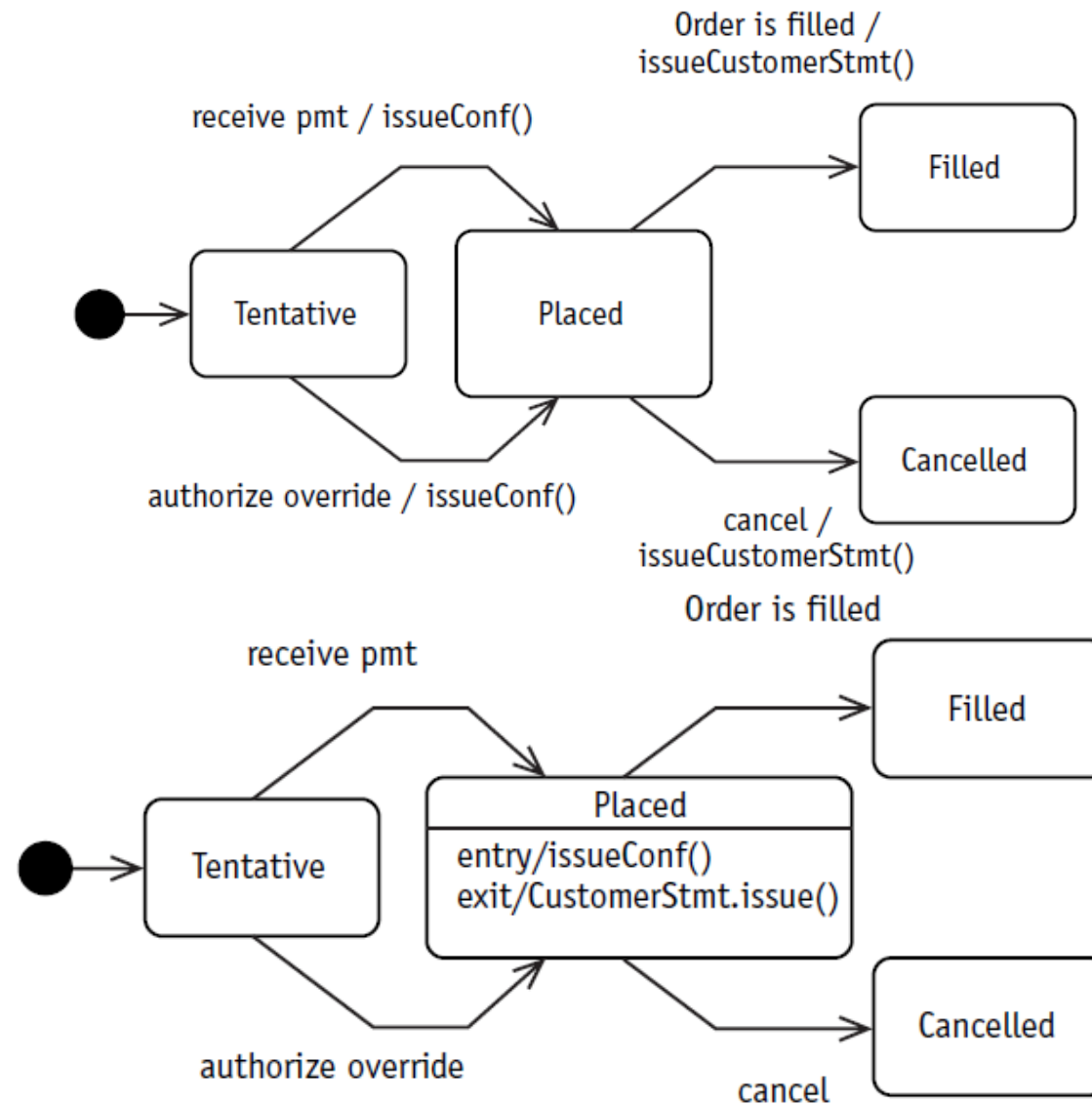
ORDER OF EVENTS (EXAMPLE)

- When an event **(E2)** occurs, the order of execution runs like this:

  1. If an activity is in progress in the current state (**A1**), interrupt it (gracefully if possible).

  2. Execute the exit: action(s) – **X2**

  3. Execute the actions associated with the event that started it all – **X3**

  4. Execute the entry: action(s) of the new state – **X4**

  5. Execute the activity or activities of the new state – **B1**
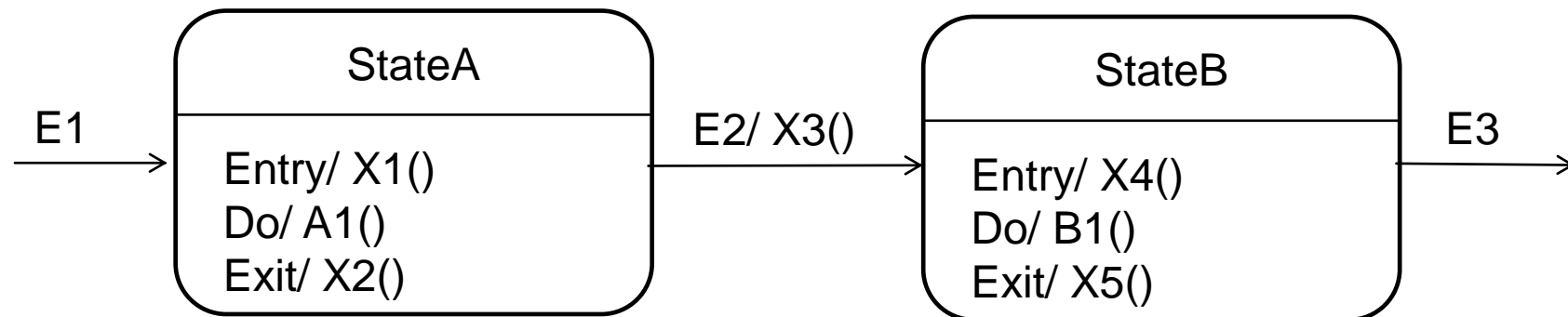
```
                    ┌──────────────────┐                      ┌──────────────────┐
     E1             │     StateA       │     E2/ X3()         │     StateB       │    E3
 ──────────────────▶│──────────────────│──────────────────▶  │──────────────────│──────────▶
                    │ Entry/ X1()      │                      │ Entry/ X4()      │
                    │ Do/ A1()         │                      │ Do/ B1()         │
                    │ Exit/ X2()       │                      │ Exit/ X5()       │
                    └──────────────────┘                      └──────────────────┘
```

EXAMPLE

■ **Problem Statement**

We track current customer status to help avoid uncollectable receivables and identify customers worthy of preferred treatment. All customers are initially set up as prospects, but when they place their first order, they are considered to be active. If a customer doesn't pay an invoice on time, he is placed on probation. If he does pay on time and has ordered more than $10,000 in the previous six months, he warrants preferred status. Preferred status may be changed only if the customer is late on two or more payments. Then he returns to active status rather than probation, giving him the benefit of the doubt based on his preferred history.

CASE STUDIES

- ## Case 1
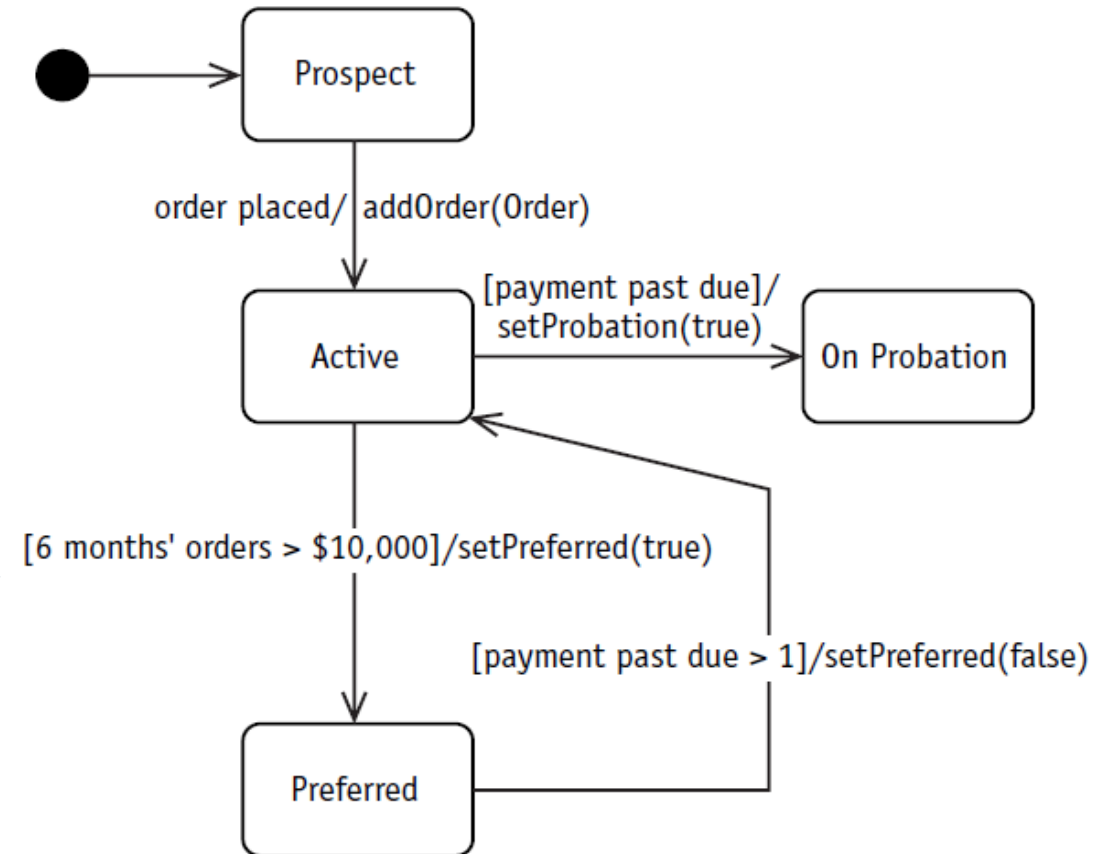
A course is initially created in offered state. The offered courses are then included by the students in their requests and the requests are placed for registration. Some of the requested courses are then had to be checked against other completed courses by the students as their pre requisites. If the pre-requisites are fulfilled students are added in the courses. When a course reaches the limit of its capacity the course is then closed for further student requests. On the other hand if there are not enough students requesting for a course the course is cancelled. Once the student registration is finished a time schedule is attached the course along with a teacher. At the end of the semester the course is evaluated by the authority. If the evaluation is satisfactory it is recommended for the next semester, otherwise it is recommended for up gradation.

CASE STUDIES

- **Case 2**

Products are first entered into our system when a request for purchase for that order is issued. A purchase order is then generated for the product and recorded with that associated product. The purchase order is then sent to the vendor. When the product is received from the vendor, it is examined by the quality control department. Once the product is approved by the quality control it is placed into inventory by recording the location where it is placed. If it is not approved the product is returned to the vendor. When a customer buys a product it is included in an invoice. Sometimes, a product is returned. In that case, you put the product back into inventory and record the location. If a product is lying in the inventory for more than six months it is returned to the vendor, but this time the vendor buys back the product in a reduced price, which means the product is included in an invoice.

CASE STUDIES

- **Case 3**

In an order processing system all customers are initially set up as prospective customers, but when they place their first order, they are considered to be active. If a customer doesn't pay an invoice on time, he is placed on notice. If he continues to keep overdue, he is given warning. If the customer doesn't pay the dues within a month of the warning, legal actions are taken against the customer. If the customer pays after the warning, he is taken back to the system as a risky customer. Only when he has a good record of transaction for six months he is taken as regular customer. If an active customer does pay on time and has ordered more than $10,000 in the previous six months, he warrants preferred status. Preferred status may be changed only if the customer is late on two or more payments. Then he returns to active status rather than probation, giving him the benefit of the doubt based on his preferred history. Sometimes an active customer can become preferred customer if the management has special issues with the customer. The customer information is archived for good if the customer dies or if there has been no transaction with the customer for more than five years.

CASE STUDIES

- **Case 4**

A student object is created as prospective student when he submits the admission form to a university. Student information is verified against the admission requirements and if he meets all the requirements he is asked to sit for an admission test. But if the student doesn't meet the requirements, he is rejected and the student object is deleted permanently from the system. Any student who fails in more than two subjects in the admission exam is also rejected. Students who pass in all the subjects or fail in one or two subjects are called for viva. At the viva the students who failed one or more subjects are given conditional admission with non-credit courses. Students who pass all the subjects are given regular student status. All sorts of admitted students are required to go through pre-advising to select appropriate courses for the semester. Once courses are selected students pay for the courses they have taken and become registered students of the semester. After each semester the student grade is evaluated and in case of low CGPA, the student becomes a probation student. High CGPA students are granted scholarships provided that they apply for it and fulfill the requirements. Probation students have to go through evaluation every semester and if the CGPA of the student doesn't improve the studentship is cancelled from the university. After successful completion of the course a regular student becomes a graduate student and all the information of a graduate student is archived.

REFERENCES

❑ Booch, G., Rumbaugh, J. & Jacobson, I. (2005). *The unified modeling language user guide*. Pearson Education India.