31269: Business Requirements Modelling

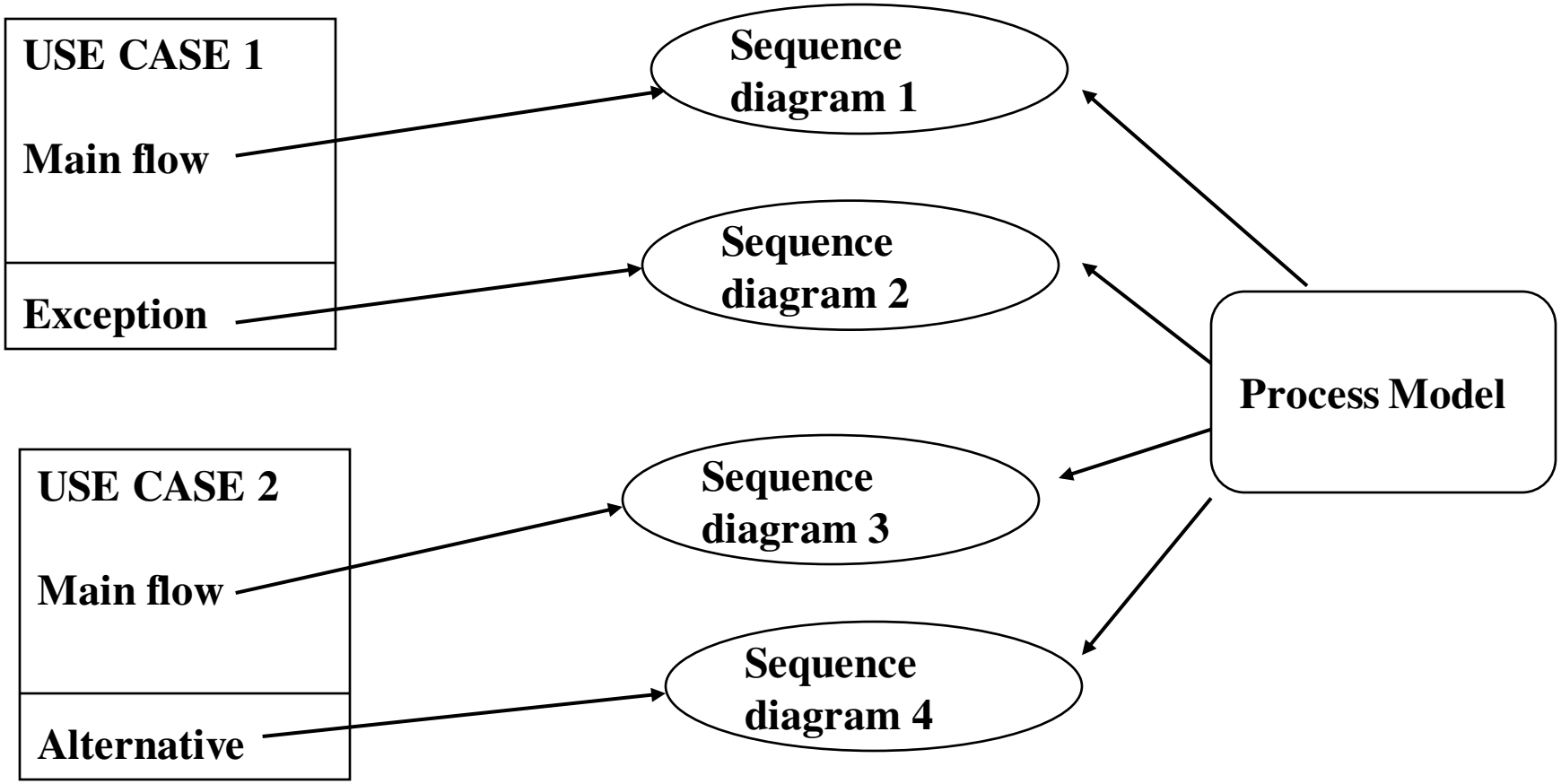
Lecture 8: Object Oriented Models with UML - Interaction Modelling with Sequence Diagrams

- ✓ Reference for reading
  - ✓ Object Oriented Systems Analysis and Design Using UML, 4th Edition by Bennnett, McRobb and Farmer
  - ✓ Applying UML and Patterns, 3rd Edition by Larman

Object Oriented Modelling

- Last Week
  - Class Modelling
- This Week
  - Interaction Modelling (Sequence Diagrams)
  - How do objects (or actors) interact with each other (or the system of interest) to execute the functionality of a use case narrative/scenario

Interaction Diagram (Sequence Diagram): Relationship with Use Cases and Process Model



Interaction Diagrams

- The UML includes Interaction Diagrams to illustrate **how objects interact via messages.**

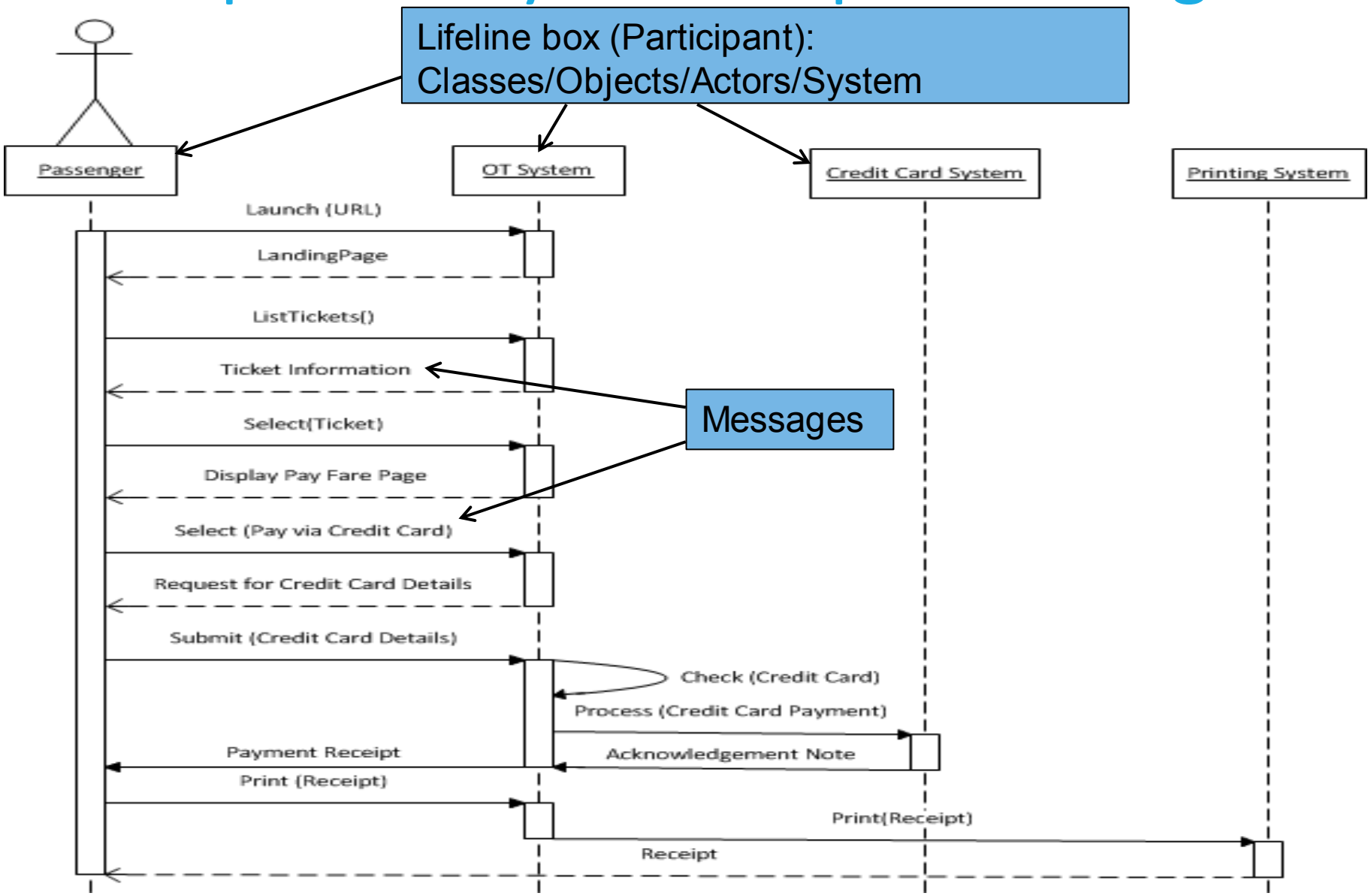
- Interaction diagrams model how group of objects collaborate to perform some behaviour. Interaction diagrams should be used when you want to look at the behaviour of several objects within a single use case.

- There are two types of Interaction Diagrams:
  - Sequence Diagram
  - Collaboration Diagram

Sequence Diagram: What is it and its purpose

- Sequence Diagram:
  - A graphical/**visual representation of a scenario/narrative of a use case**. Typically, it **captures the behaviour of one use case** and visualises a use case.
  - Objects are identified in the process or use case narrative and represented as a “Lifeline box” (see next slide).
  - Shows communication between the identified objects in terms of **messages** that are passed from source to target lifeline over a period of time (see next slide).
  - Shows a succession of **interactions (methods) between classes or object instances** over time in a sequence.

Example of a System Sequence Diagram



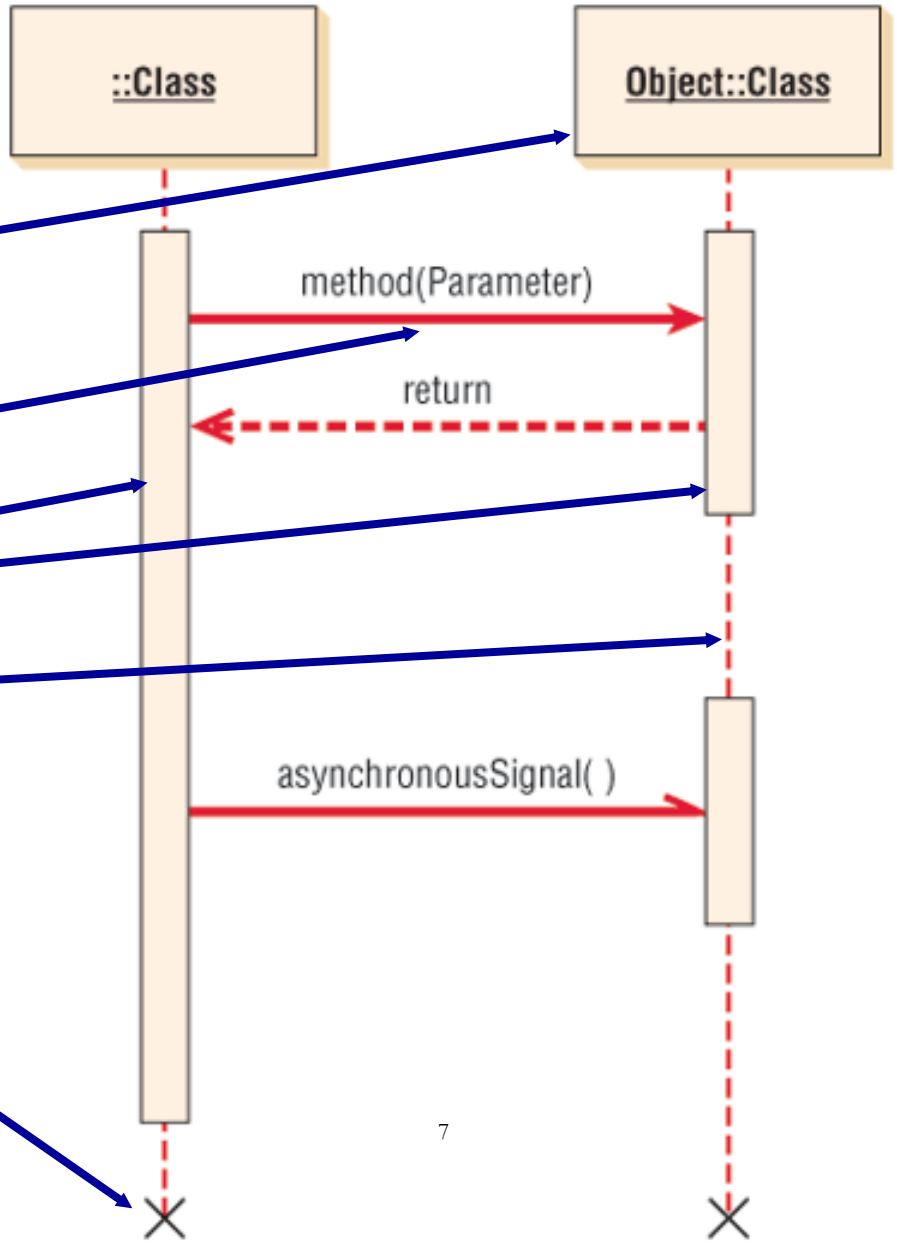
Sequence Diagram: Notations

- Lifeline box representing a **participant**: System, Object, Actor (Class)

(*object name: ClassName*)

- Message line
- Activation bar (execution bar)
- Lifeline
- The X at the bottom of an Activation bar indicating object destruction (optional)

Figure 18.12
Specialized symbols used to draw a sequence diagram.



Sequence Diagram Components

- Sequence diagrams illustrate interactions in a kind of **fence format**, in which each new object is added to the right as shown on previous slide.
- Sequence diagrams have a **tabular layout**
  - Columns and Rows
- Columns
  - **Lifeline box**– an individual **participant (Object/Class/Actor)** in a sequence diagram represented in a rectangular box
  - Objects represented as "Lifeline box" are column "Headings"
  - **Activation/execution bar** shows the period of time during which an operation/method executes and is shown along the lifeline. It indicates the focus of control and **how long the object is active.**
  - First Lifeline or column initiates the interaction or communication
- Rows
  - Messages are in the rows and messages are sequenced in **Time Order** from top to bottom

Sequence Diagram Components

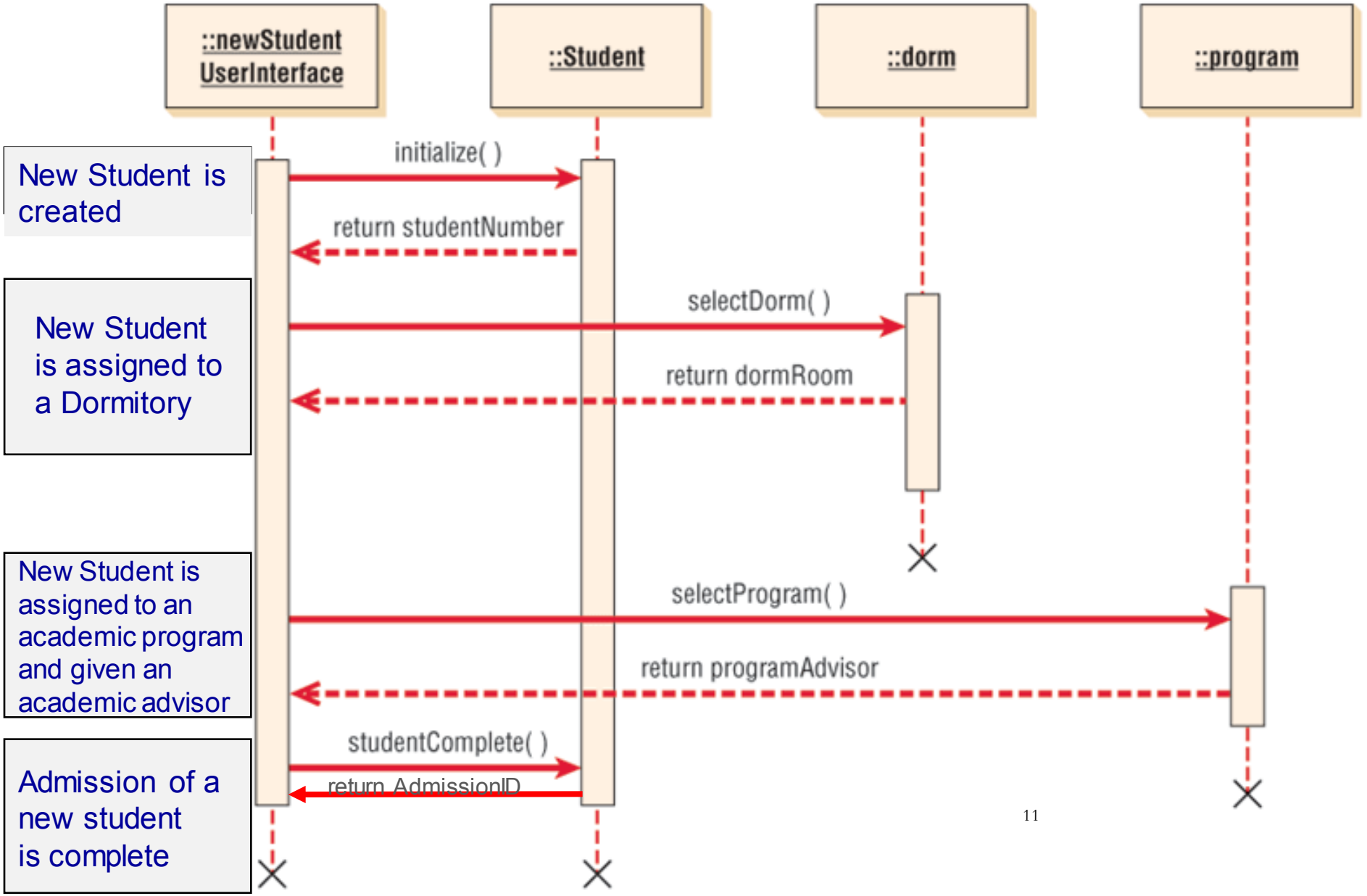
- Lifeline Boxes and Lifelines
  - Object or Actor or System composed of objects
  - Lifeline boxes include a dashed **vertical line** extending below them which represents the actual **lifeline** of an object during interaction.

- Message
  - Synchronous
  - Asynchronous
  - Self-Message
  - Conditional Message
  - Loops or Iterations
  - Alternative “alt” and Optional “opt” fragments

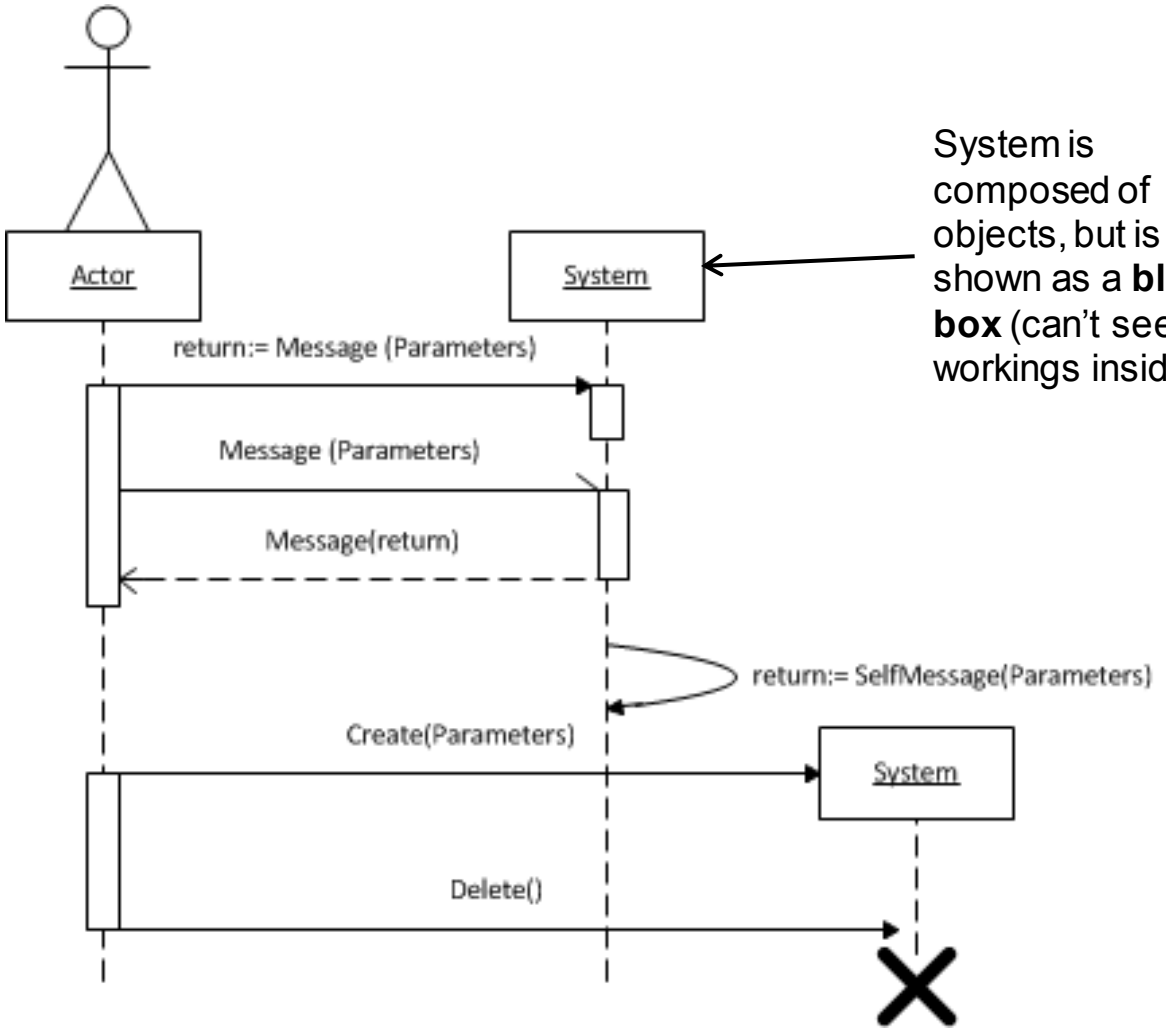
Sequence Diagram: Messages

- Horizontal arrows represent messages or signals sent between classes.
  - Solid arrowheads represent **synchronous calls** (the sending class waits for a response). 
  - Synchronous calls are more like **functions** (value returning methods).
  - Half arrowheads represent **asynchronous calls** (sent without waiting for a returning signal). 
  - Asynchronous calls are like **procedures** (void methods).
  - See the notes section of this slide

A sequence diagram for student admission. Sequence diagrams emphasize the time ordering of messages.



System Sequence Diagram



System is composed of objects, but is shown as a **black box** (can't see its workings inside it)

System Sequence Diagram shows interaction between Actor and System as a black box.

Sequence Diagram: (Where to from here?)

- User Stories (two weeks ago)

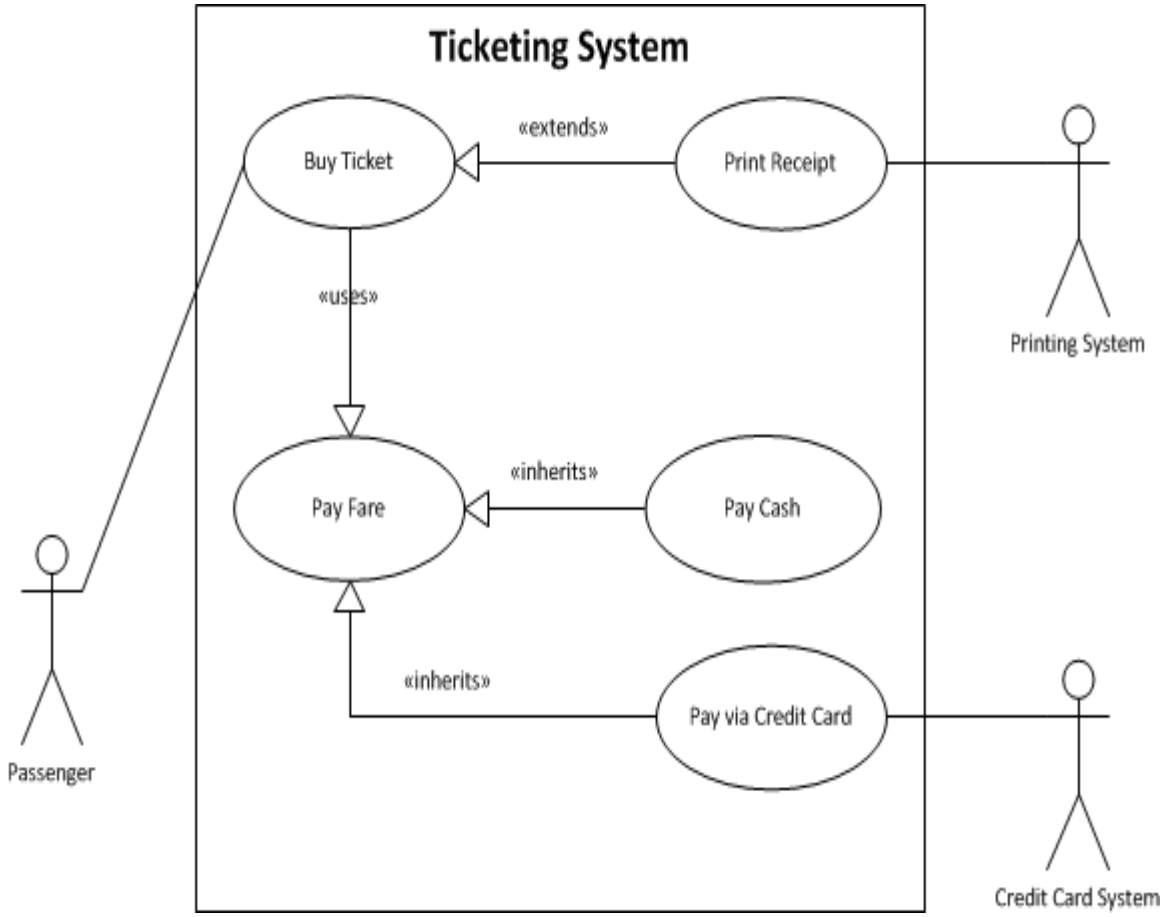
- Use Case Diagram (last week)

- Use Case Scenarios or Narratives (last week)

- Sequence Diagram (one diagram for each use case narrative)

Read each use case narrative and identify Participants and messages via which these participants interact with each other.

Use Case Diagram from Week 7 Lecture



Steps in drawing a Sequence Diagram for Buy Ticket Use Case Narrative

- Refer the Buy Ticket use case narrative from Week 7 Lecture available in week 7 folder on uts online.
- Read the narrative and follow the following steps:
  - Find Participants: Classes/Objects (look for nouns)
  - Identify messages/methods by finding verbs and verb phrases. These will become your messages in the sequence diagram.

Buy Ticket Use Case Narrative – from Week 7 Lecture

Buy Ticket Use Case Narrative

Use Case ID	UC101: Buy Ticket
User Story	As a passenger, I want to buy a ticket via Online Ticketing System so that I can travel from one city to another city in Australia.
Goal	Buy a ticket online for traveling from one destination to another destination.
Priority	H
Actors	Primary Actor – Passenger Secondary Actor – Credit Card System, Printing System
Pre-conditions	The passenger has access to the Online Ticketing System. The passenger has a valid credit card.
Post-conditions	The passenger has successfully bought the ticket via the Online Ticketing System.
Trigger	The passenger launches the Online Ticketing (OT) system via their internet browser.
Main Flow	1. The (OT) system displays the OT system landing page and displays the hyperlink to list the available tickets i.e. departure, destination, types, dates and fare. 2. The passenger clicks on the hyperlink to list the available tickets. 3. The OT system displays the available tickets to select from. 4. The passenger selects the desired ticket and presses the "Buy Ticket" button. 5. The OT system displays the **"Pay Fare"** page for the selected ticket and requests for payment. 6. The passenger chooses to "**Pay via Credit Card**". 7. The OT system asks the passenger to enter their credit card details. 8. The passenger submits the credit card details. 9. The OT system checks the credit card number format and processes the credit card details via the **"Credit Card System"**. Please see **"UC102: Pay via Credit Card"** for credit card payment processing details. 10. The OT system successfully receives the payment via the **"Credit**

System Sequence Diagram for "Buy Ticket"

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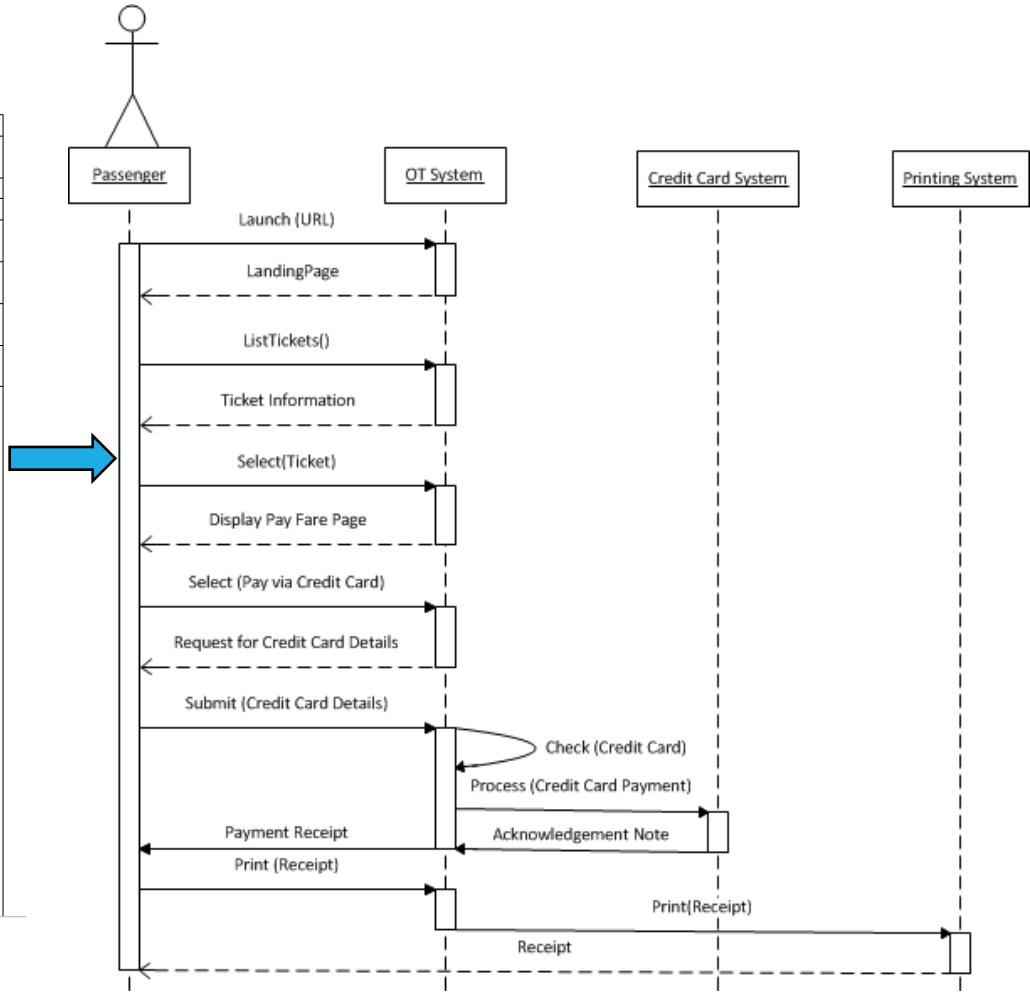
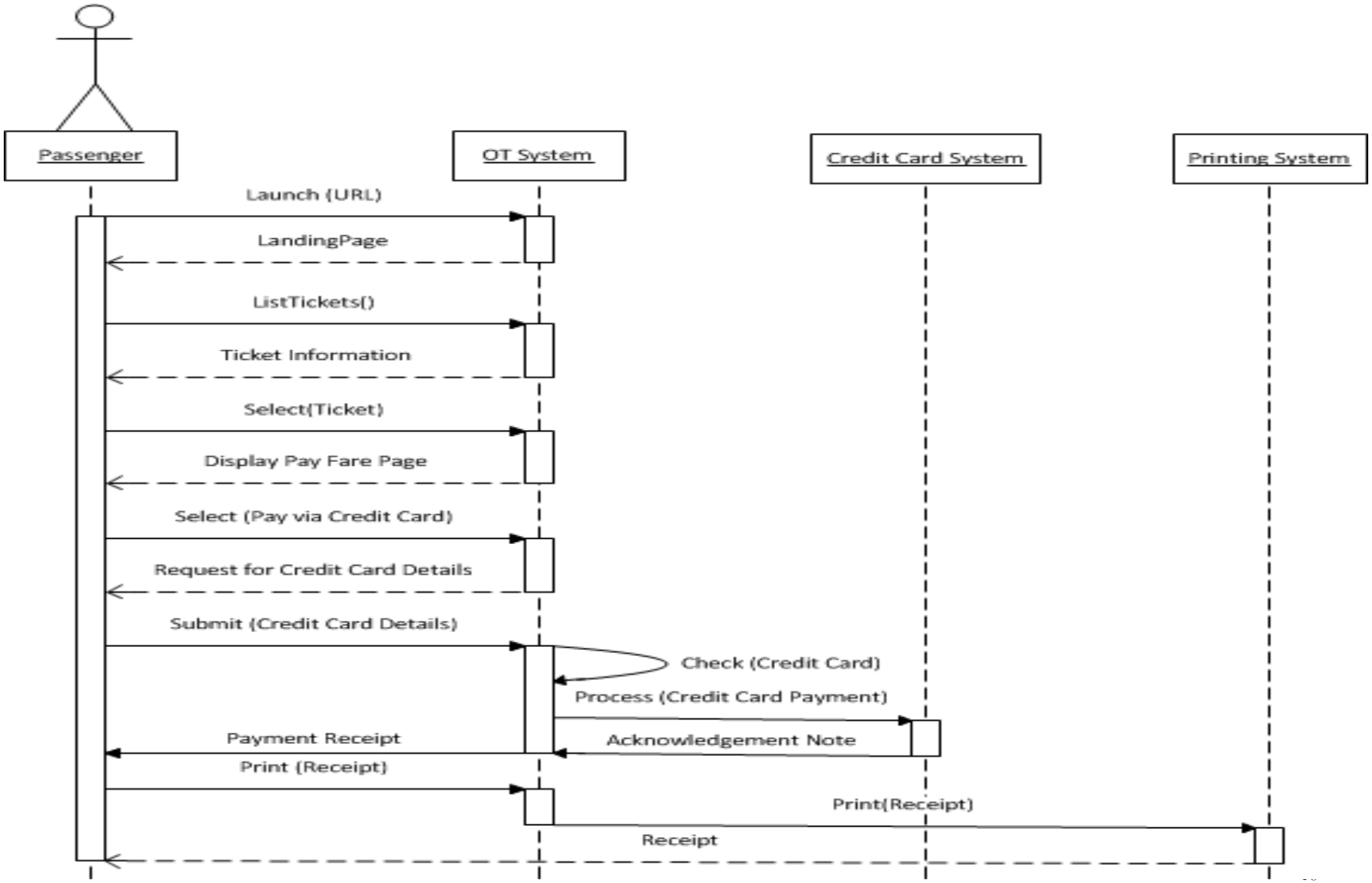


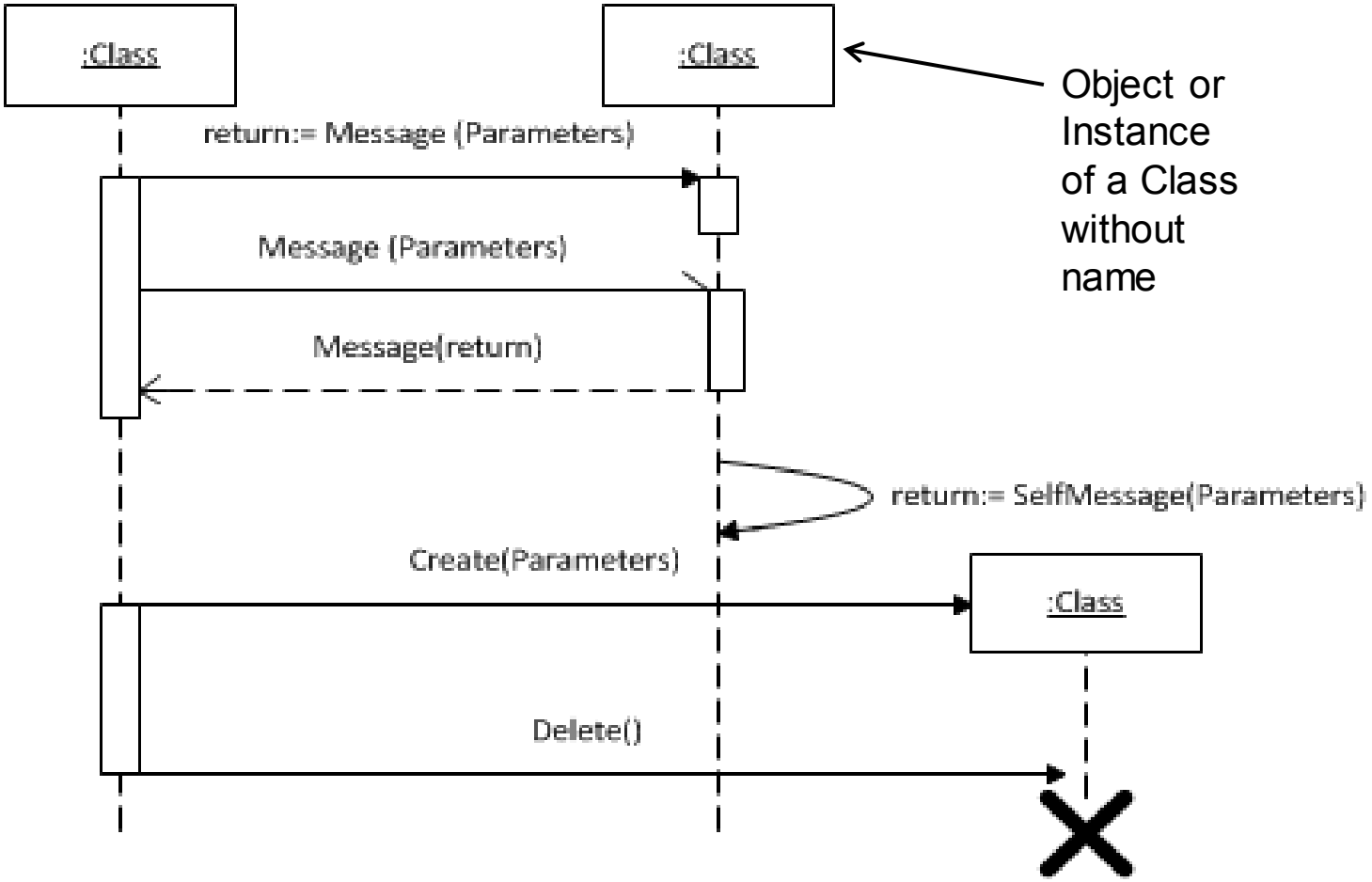
System Sequence Diagram shows interaction between Actor and System (OT System) as a black box.

System Sequence Diagram for “Buy Ticket” use case



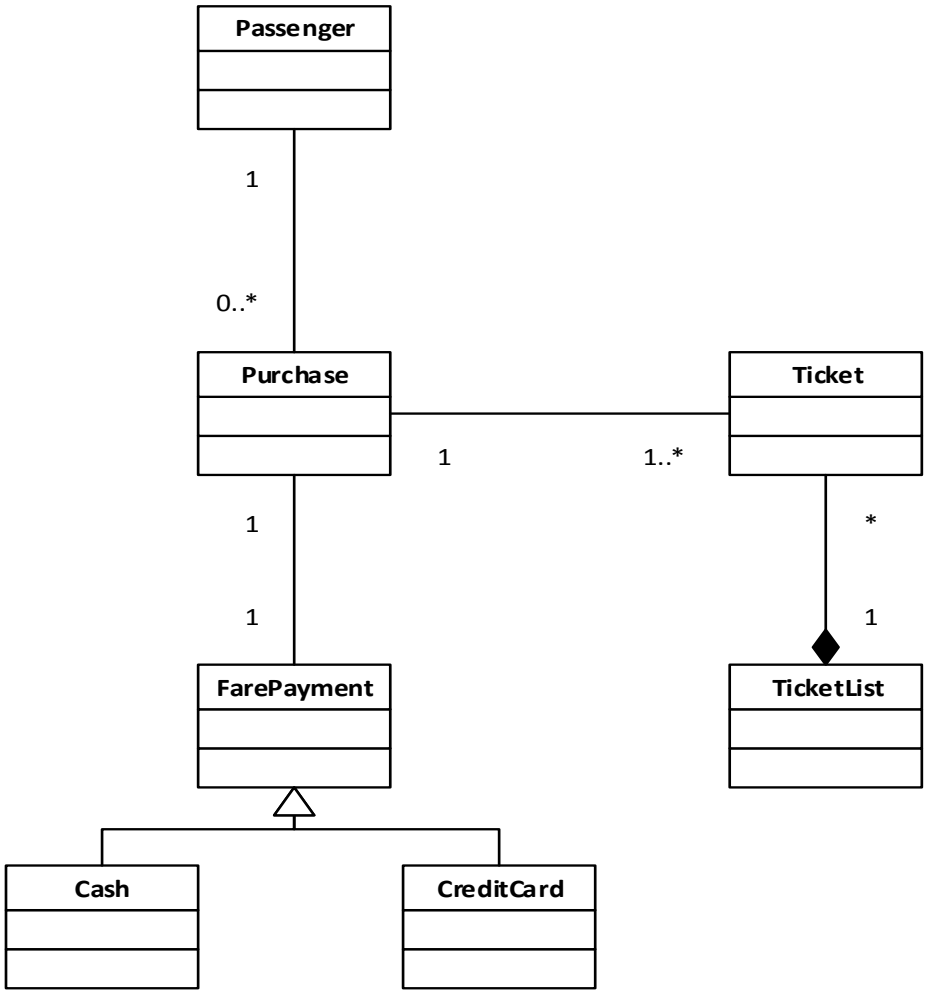
Object Sequence Diagram (at Object level)

Shows all the objects within the System



Object Sequence Diagram is used generally to show interactions between the objects identified within the system of interest (objects within OT System)

Class Diagram from last week revisited



Object Sequence Diagram (interaction between objects of OT System)

- Shows all the objects within the OT System

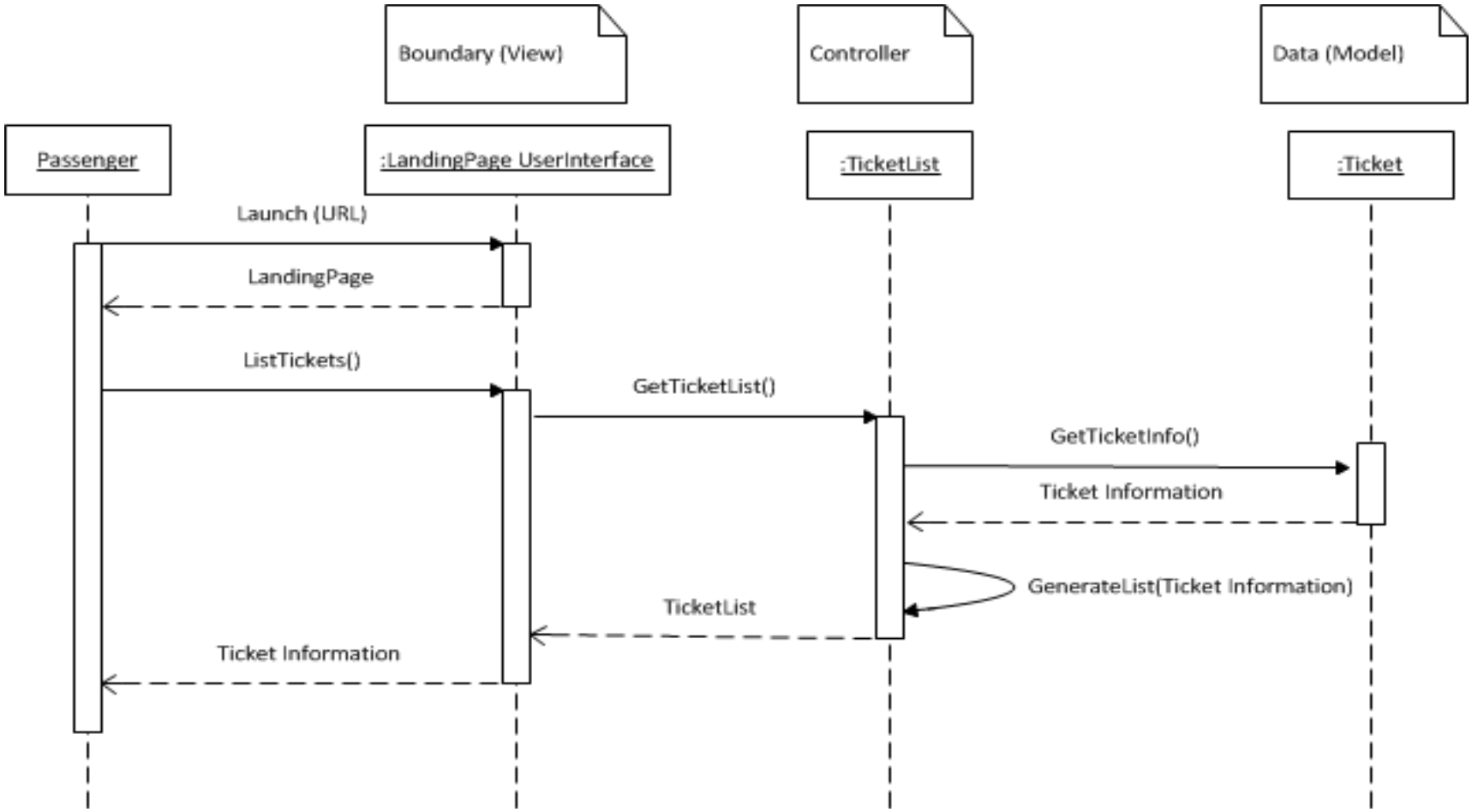
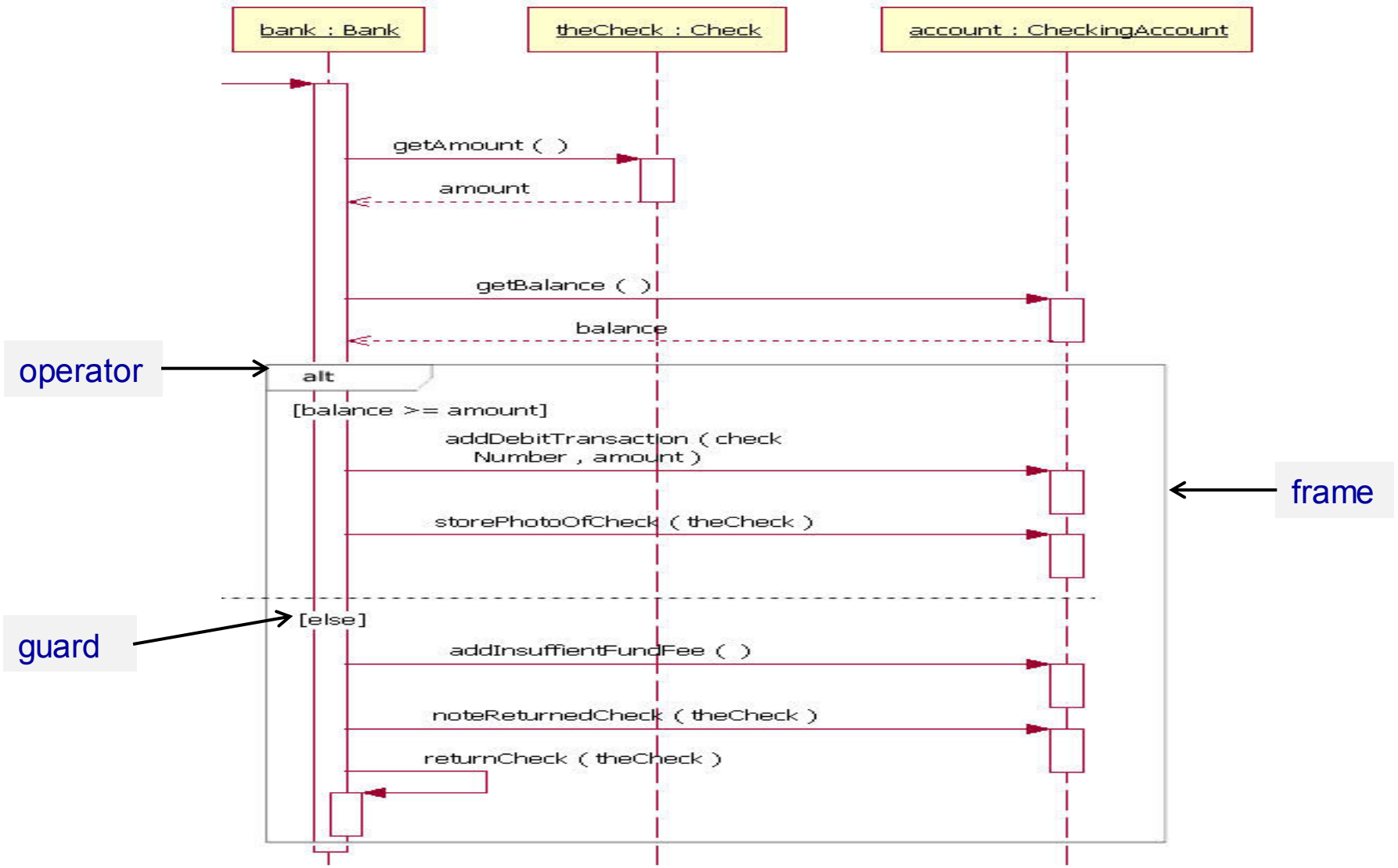


Diagram Frames in Sequence Diagram

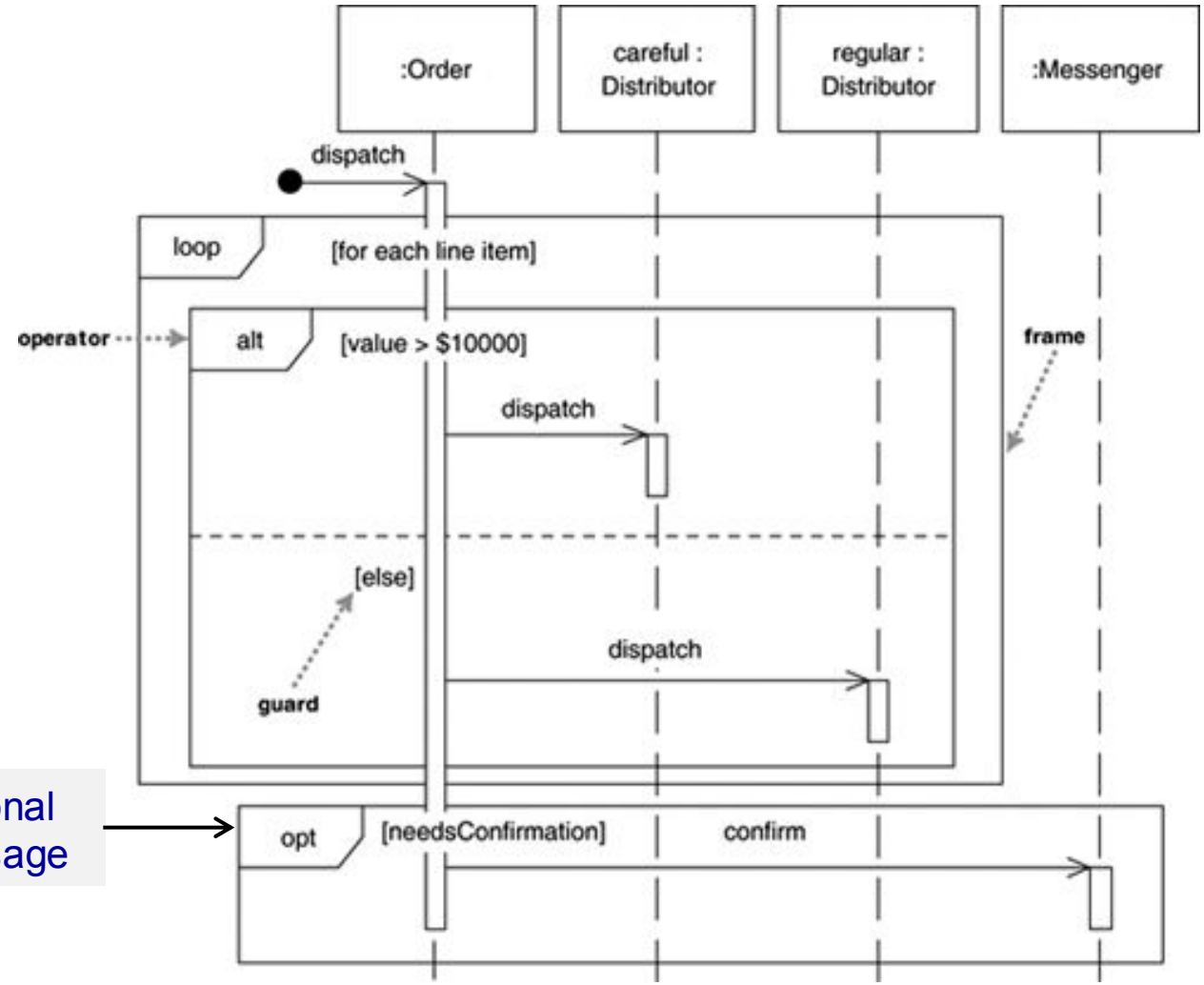
- To support conditional and looping constructs, the UML uses **frames.**
- Frames are regions or fragments of the diagrams; they have an operator or label (such as loop) and a guard (conditional clause).

- Some common frame operators:
  - **alt**: For conditional messages (for example, if condition)
  - **loop**: To implement a looping or iterative message
  - **opt**: Optional fragment that executes if guard is true. Could be used for exceptions in a use case narrative.

Sequence Diagram Conditional Messages



Sequence Diagram: Iterative Messages



Optional message

Example Scenario – Booking a room

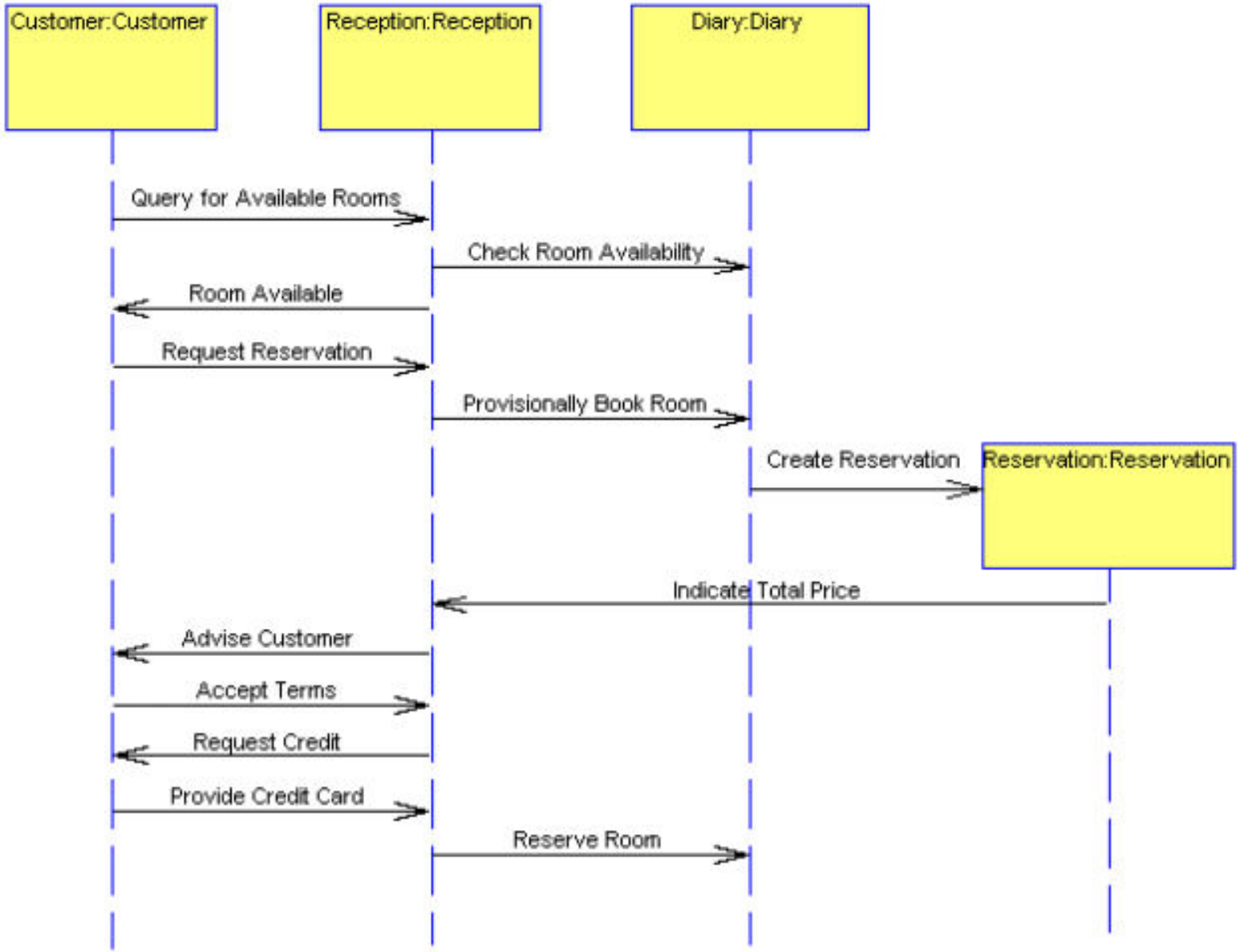
- Customer queries for available rooms
- Store customer details
- Check diary for room availability
- Room is available
- Advise customer of availability
- Customer requests reservation
- Provisionally book room
- Figure out price and advise customer
- Customer accepts terms
- Provisionally book room
- Check customer credit
- Customer credit Is OK
- Reserve room

Step 1: Identify Participants: Classes/Objects (Nouns)

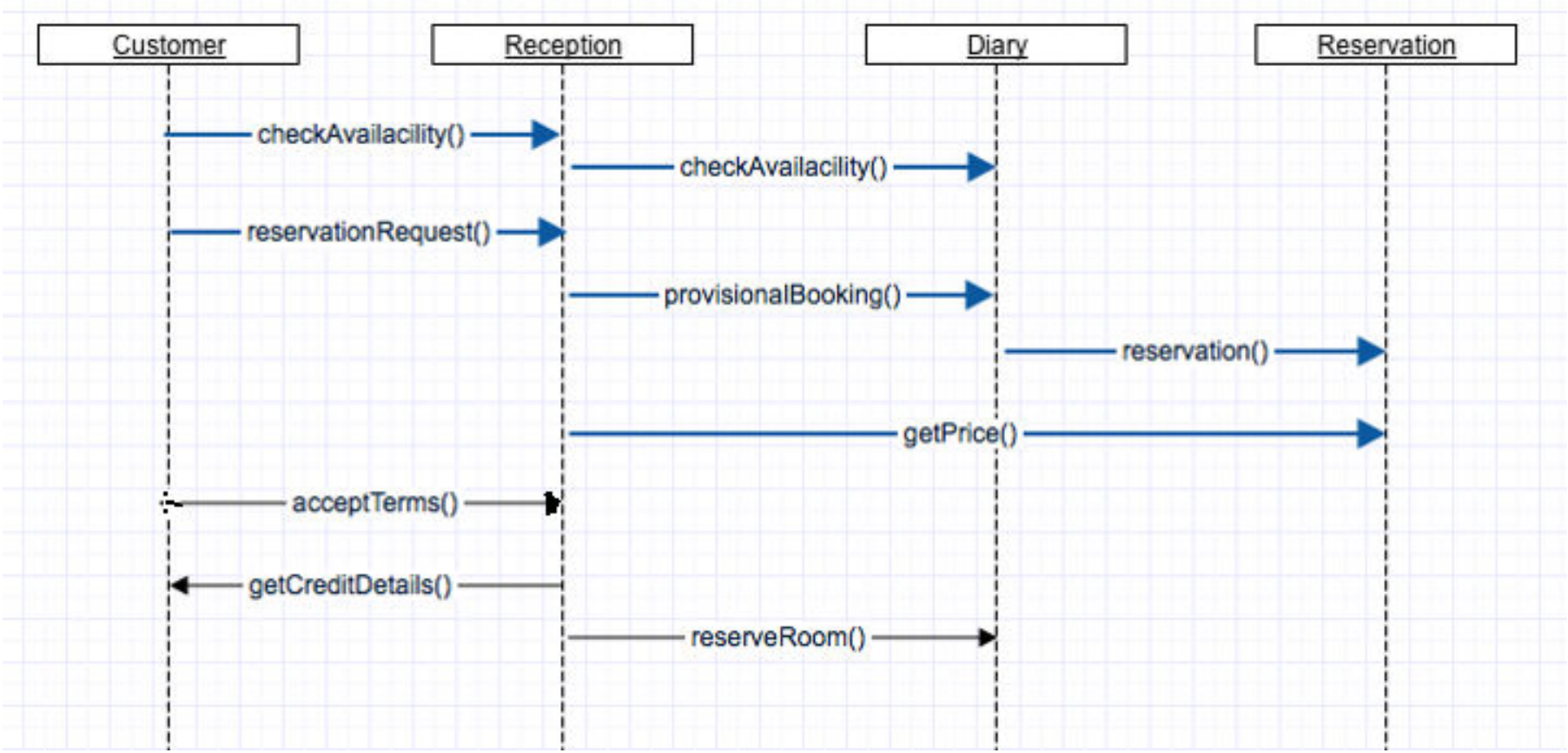
- **Customer** Queries for Available **Rooms**
- *Store* **Customer** Details
- *Check* **Diary** for Room Availability
- **Room** is Available
- *Advise* **Customer** of Availability
- **Customer** Requests Reservation
- Provisionally Book **Room**
- Figure Out Price and Advise **Customer**
- **Customer** *Accepts* Terms
- *Provisionally Book* **Room**
- *Check* **Customer** Credit
- **Customer** Credit Is OK
- *Reserve* **Room**

Step 2: Identify Messages/Methods (Verbs)

- Customer **Queries** for Available Rooms
- ***Store*** Customer Details
- ***Check*** Diary for Room Availability
- Room is Available
- ***Advise*** Customer of Availability
- Customer **Requests** Reservation
- *Provisionally* ***Book*** Room
- Figure Out Price and Advise Customer
- Customer ***Accepts*** Terms
- ***Check*** Customer Credit
- Customer Credit Is OK
- ***Reserve*** Room

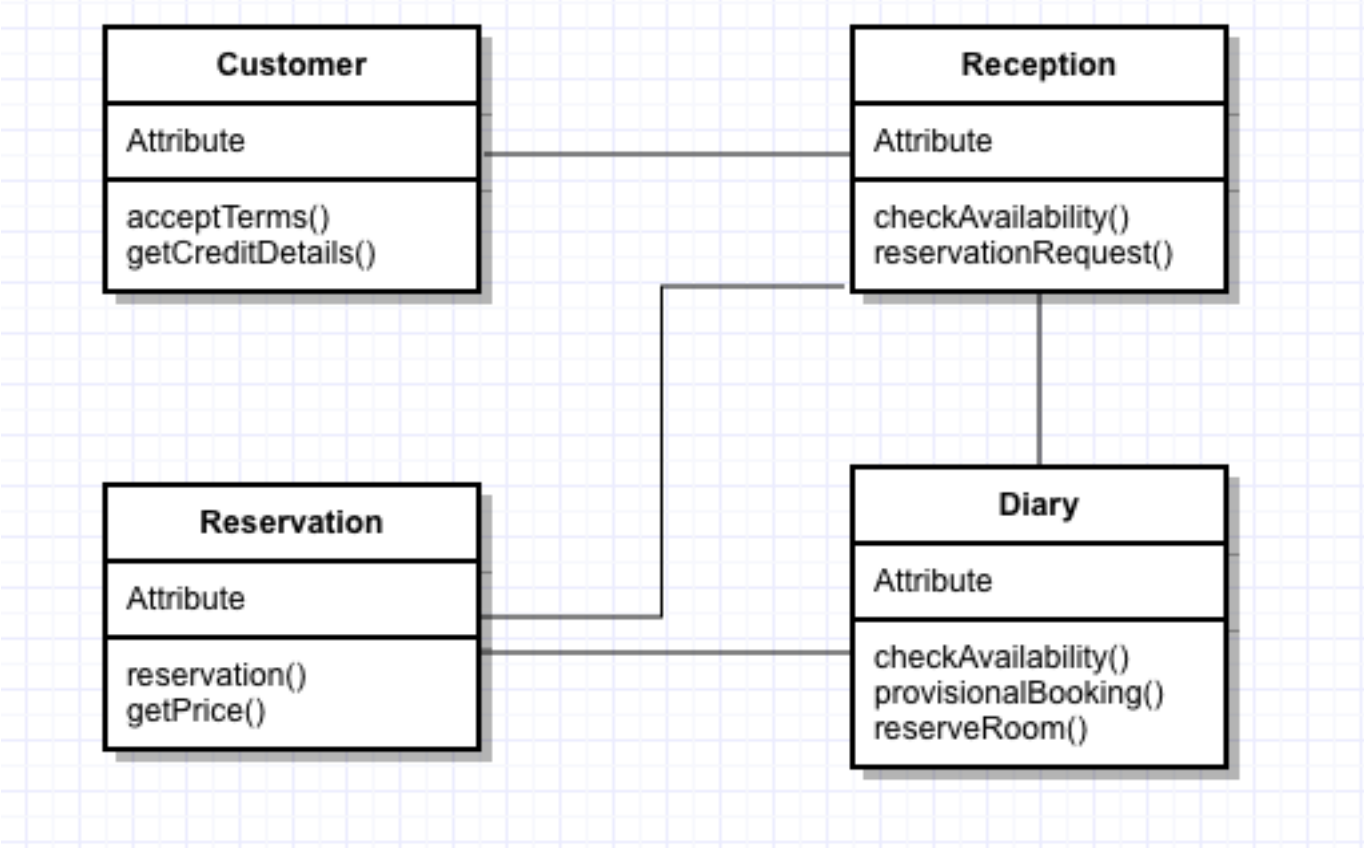

Customer:Customer
Reception:Reception
Diary:Diary
Query for Available Rooms
Check Room Availability
Room Available
Request Reservation
Provisionally Book Room
Create Reservation
Reservation:Reservation
Indicate Total Price
Advise Customer
Accept Terms
Request Credit
Provide Credit Card
Reserve Room

More Formal



Please see the notes section.

Relationship between Class Diagram and Sequence Diagram



Class diagram (developed earlier) should be updated after developing sequence diagrams.

- Addition of new methods
- Deletion of (never used) methods
- Addition of new classes (created during the sequence diagrams)

Summary

- Lifeline box: Actor or System or Object
- Lifeline
- Interaction or Communication
- Sequence
- Messages

Assignment 2 – Due on 27 May

- Object Oriented Requirements Analysis and Specification Report – 18 Marks
- ***So far you should have finished the following for assignment 2:***
  - ***User Stories (minimum six):*** Identify all possible User Stories. You should have at least six user stories. At least two of your user stories should be from the Customer's perspective, and two user stories from the "Ka-ching" Team's perspective.***and***
  - ***Use Case Narratives:*** Document/narrate four Use Cases based on four user stories; two user stories from the Customer's perspective, and two user stories from the "Ka-ching" team's perspective.
  - ***By now you should have got feedback from your tutor.***
- ***<u>Hint:</u> Convert any two Use Case Narratives into two Sequence Diagrams.***

  Document two Sequence Diagrams; any one for Customer use case and any one for "Ka-ching" Team use case.

Conclusion

- This Week's Workshop
  - **Quiz 7 – Class Modelling (3 marks)** and
  - Tasks – Interaction Modelling

- Next Week's Lecture
  - State and Event Modelling

- Next Week's Workshop
  - **Quiz 8 – Interaction Modelling (3 marks)** and
  - Tasks – State and Event Modelling