Tutorial - UML Introduce 3

> Designed by ZHU Yueming
>
> Reference
>
> 1. Bernd Bruegge and Allen H.Dutoit, Object Oriented Software Engineering Using UML, Patterns, and Java Third Edition
> 2. Zhang Yuqun, Slides of Object Oriented Analyze and Design
> 3. Wang Wenmin, Slides of Object Oriented Analyze and Design

Experimental Objective

1. Learn how to design sequence diagram.
2. Need to understand methods are declared in which objects according to a given sequence diagram.

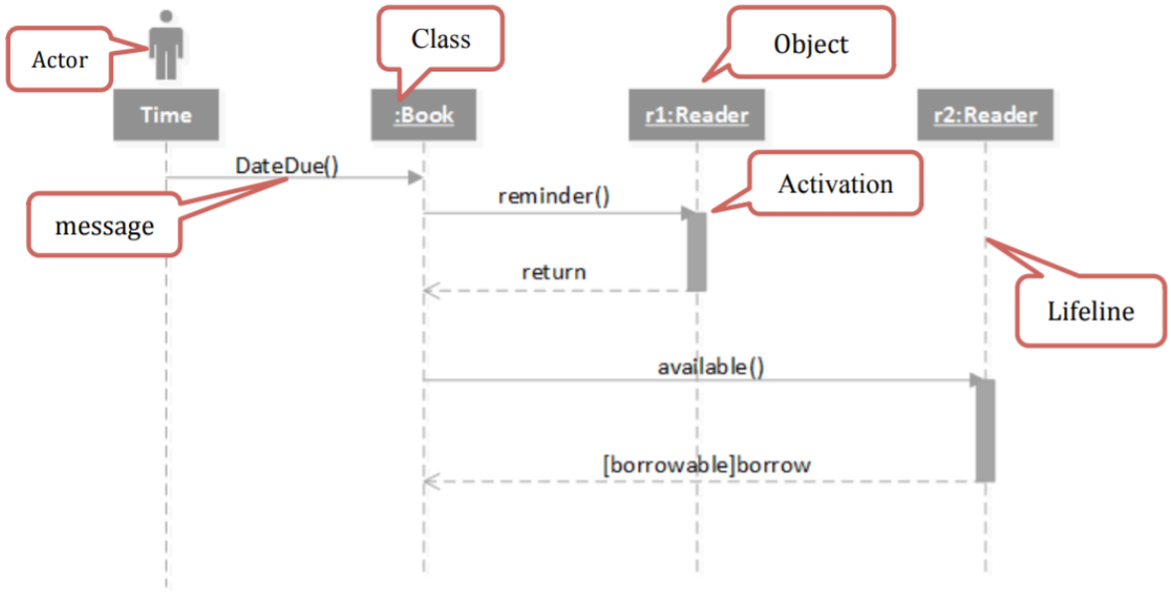
Topic 3. Sequence Diagram

1. General Introduction

Sequence diagrams are a kind of interaction diagram, because they describe how—and in what order—a group of objects works together. These diagrams are used by software developers and business people alike to understand requirements for a new system or to document an existing process. Sequence diagrams are sometimes known as event diagrams or event scenarios

Sequence Diagram Components

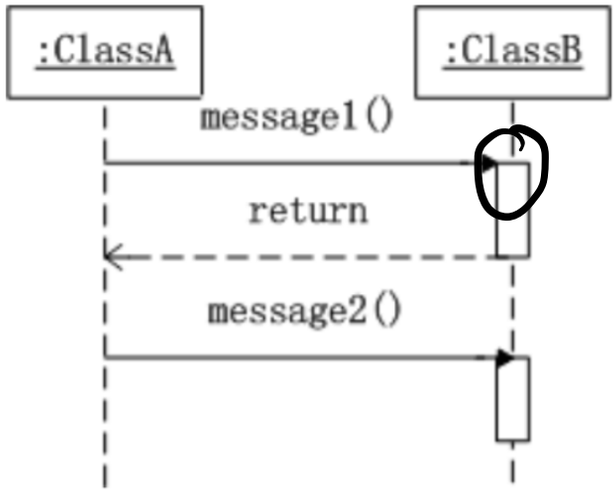
1. **Actor(角色)**: Represented by a stick figure, actors are entities that are both interactive with and external to the system.
2. **Object(对象)**: This box shape represents a class, or object, in UML. They demonstrate how an object will behave in the context of the system. Class attributes should not be listed in this shape.
3. **Lifeline(生命线)**: A dashed vertical line that represents the passage of time as it extends downward. Along with time, they represent the sequential events that occur to an object during the charted process. Lifelines may begin with a labeled rectangle shape or an actor symbol.
4. **Activation(激活期)**: Symbolized by a rectangle shape, an activation box represents the time needed for an object to complete a task. The longer the task will take, the longer the activation box.



2. Sequence Message

(1) Synchronous Message (同步消息)

Represented by a solid line with a solid arrowhead. This symbol is used when a sender must wait for a response to a message before it continues. The diagram should show both the call and the reply.

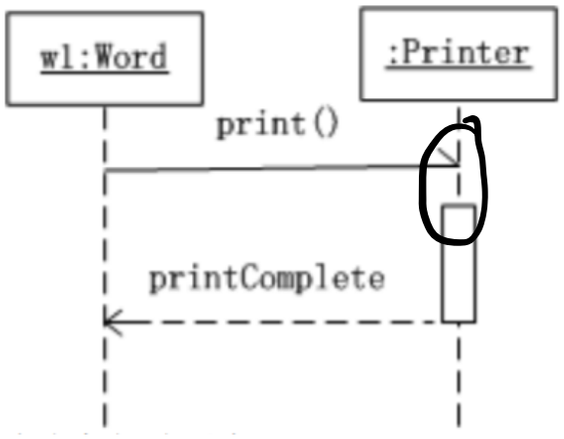


(2)Reply Message (返回消息)

Represented by a dashed line with a lined arrowhead, these messages are replies to calls.

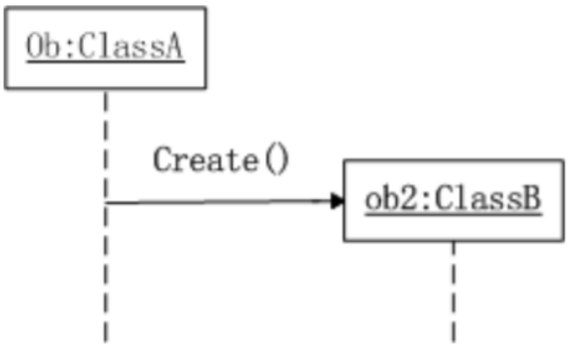
(3) Asynchronous Message (异步消息)

Asynchronous Message(异步消息): Represented by a solid line with a lined arrowhead. Asynchronous messages are those that don't require a response before the sender continues. Only the call should be included in the diagram.



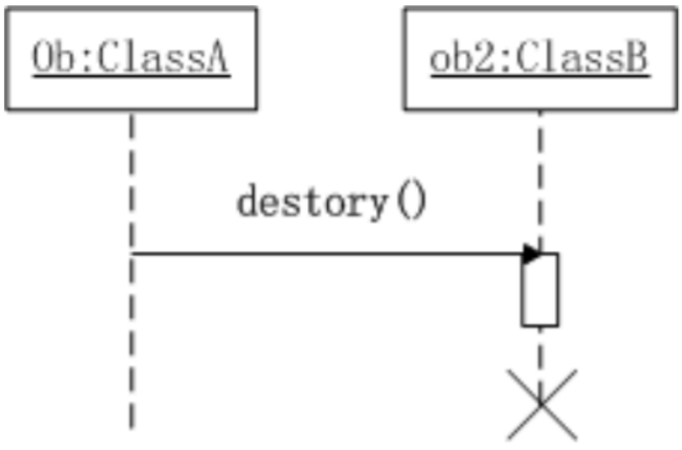
(4) Create Message (通过消息创建对象)

A create message represents the creation of an instance in an interaction. The create message is represented by the keyword “create”. The target lifeline begins at the point of the create message.



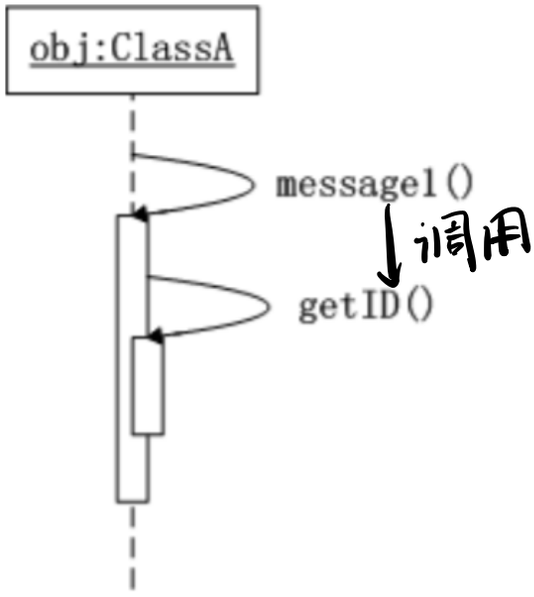
(5) Destroy Message (通过消息销毁对象)

Represented by a solid line with a solid arrowhead, followed by an X symbol, these messages indicate the destruction of an object and are placed in its path on the lifeline.

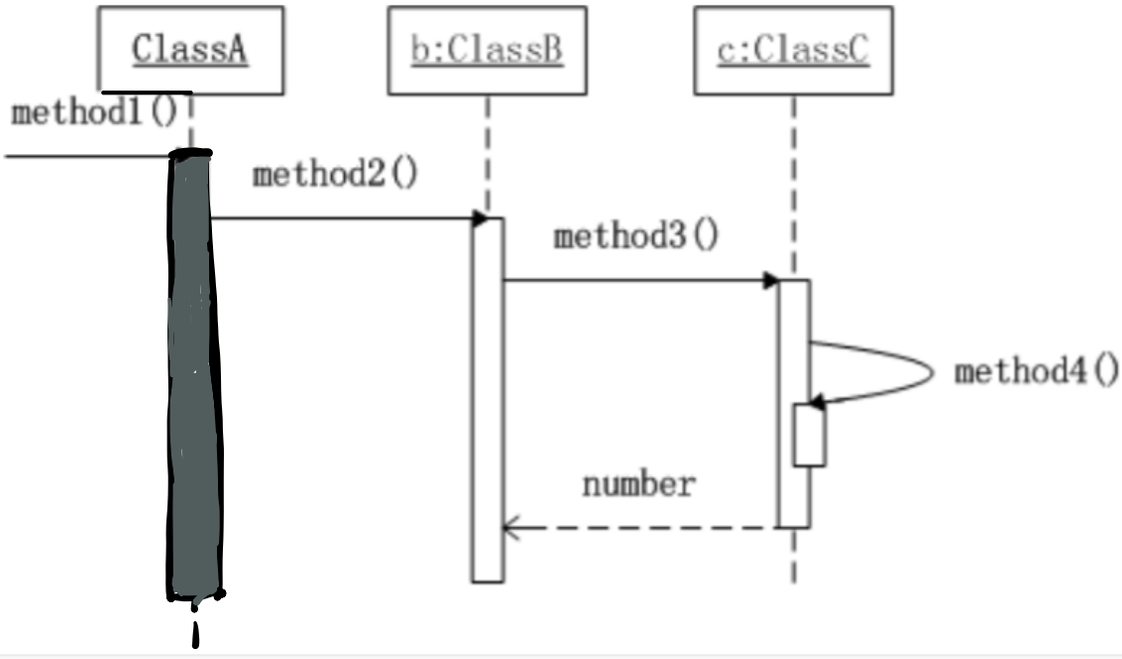


(6) Self-associative Message (自关联消息)

The message represents a message will invoke another message in the same object.



Example: The code framework of sequence diagram




```
public class classA {
    classB b;
    public void method1(){
        b.method2();
    }
}
public class classB {
    classC c;
    public void method2(){
        c.method3();
    }
}
public class classC {
    int number;
    public int method3(){
        method4();
        return number;
    }
    void method4(){}
```

```
}
```

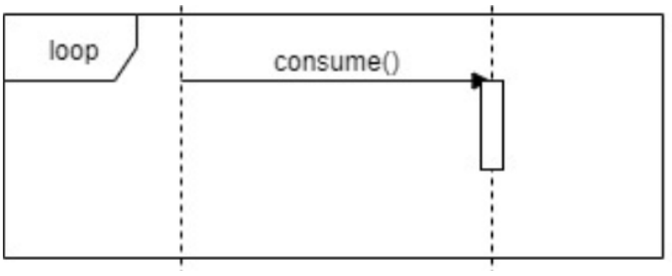
3. Sequence Fragments

UML sequence diagram can not only describe the sequence structure, but also can express the selection and loop structure, and Combined Fragment can help to achieve it. In the tutorial, we only focus on those three most commonly used structures: `loop`, `opt`, `alt`

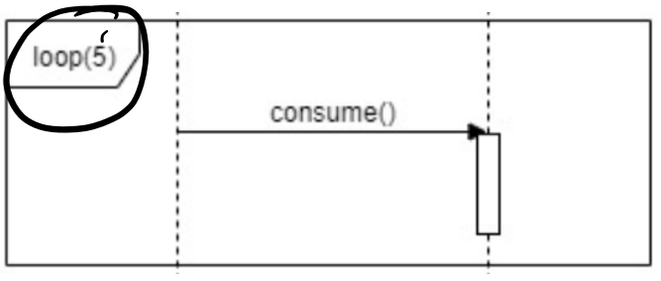
loop

If a fragment would repeat for many times, we can use `loop` fragment.

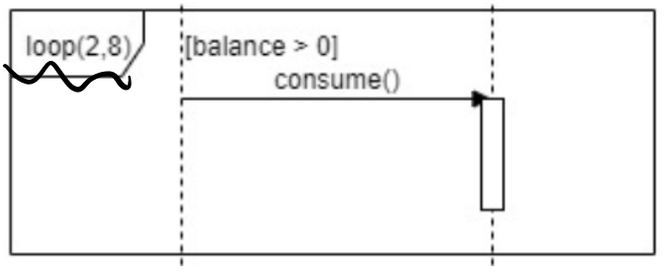
Infinite loop:



Loop with specific times:

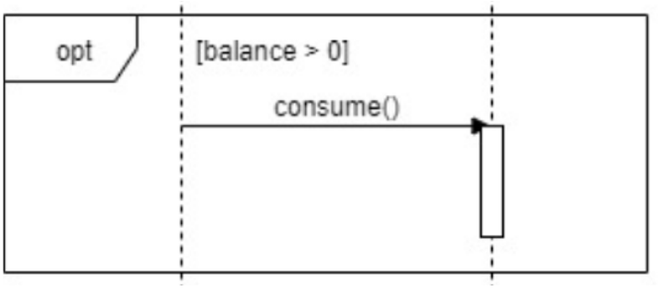


The loop iterates at least min number times and at most max number times:



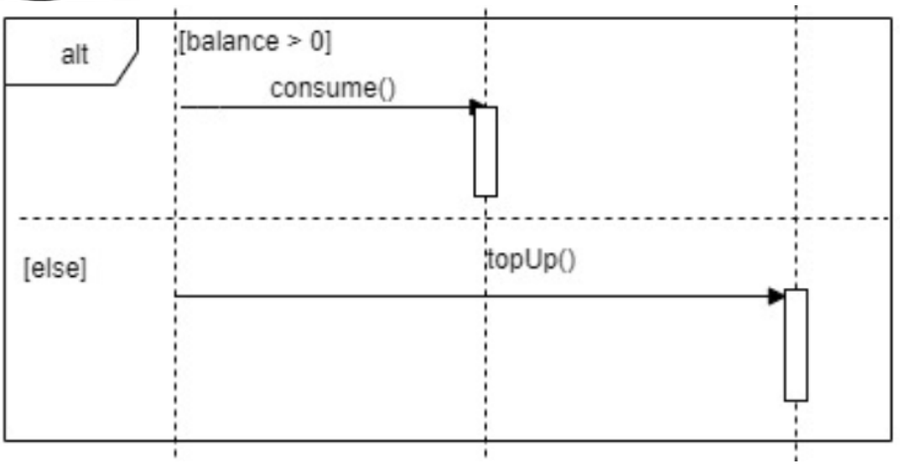
opt

Similar to `if` structure in programming



alt

Similar to `if... else if ... else` structure in programming



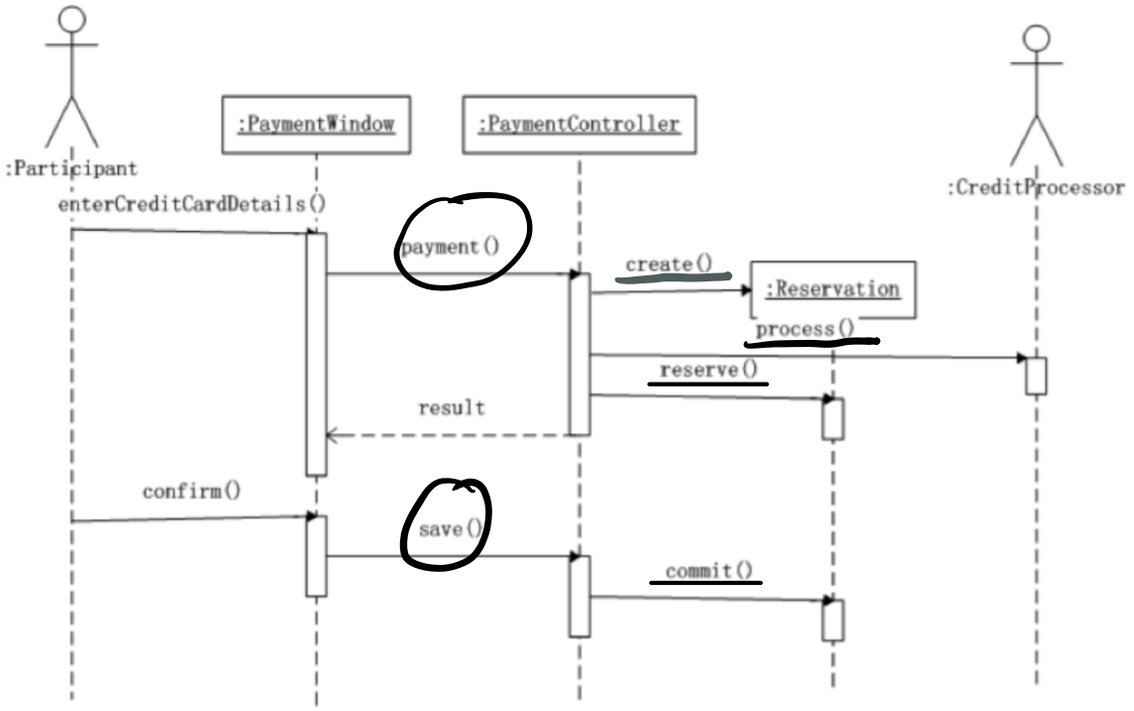
For more detailed introduction: click here

4. Basic Exercise

- **Exercise 1**

  According to the sequence diagram below, please writing down the following question.

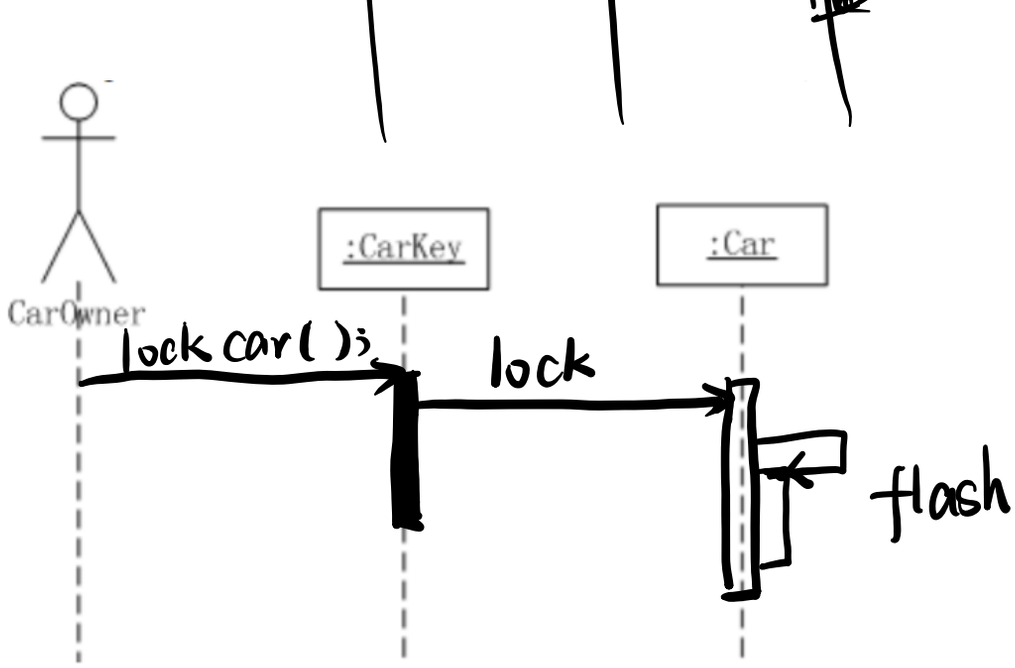
  1. List all the method should be defined in `PaymentController` class.
  2. List all the method can be invoked by `PaymentController` class



- **Exercise 2**

  The process of remote lock: When the owner presses the "lock car" button in car key, the car will automatically be locked. In the process of locking, by flashing the lights to tell the owner the process finished.

  In the process there are 3 classes or actor: `CarOwner`, `CarKey`, `Car`

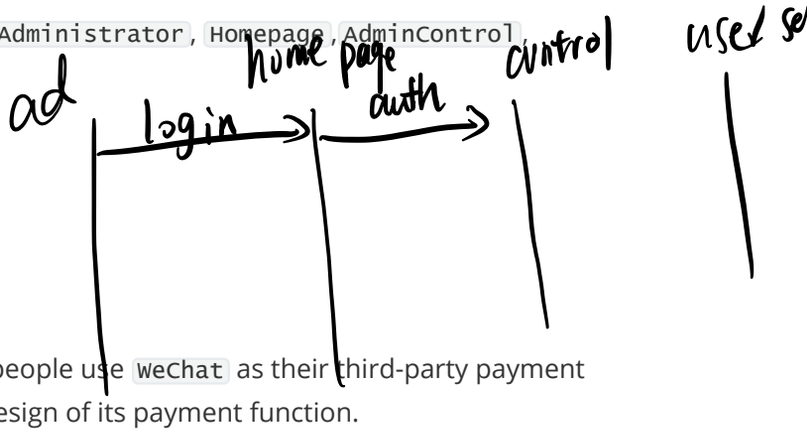


- **Exercise 3**

  Translate the following English statements into a representative sequence diagram. The process of adding a user:

  Before using the system, the `administrator` requires to fill in the login information in `home page`. After submitting the login information, the `home page` sends the information to the `administrator control unit` for authentication. After verifying, the `administrator` can add user from system `home page`. When adding user into server, the system needs to determine whether we filled is to meet the writing requirements in `home page`, and the user can be created and written into `user server` after satisfying this condition. After finishing all the operation, the system will return a successful message in `home page` to tell the user the process is successful.

  In the process there are 4 classes or actor: `Administrator`, `Homepage`, `AdminControl`, `userServer`



5. Comprehensive Exercise

5.1. WeChat Payment

Mobile payment is very popular in China. Many people use `weChat` as their third-party payment platform. The following description is a simple design of its payment function.

You can do multiple operations in `weChat` pay, including checking how much balance you have in your wallet, adding bank cards to recharge or withdraw, looking up transaction history, sending lucky money to your contacts, and making payment to strangers by a QR code. In last case, we have two ways of transaction, either the payer scanning the QR code of payee's or the payee scanning the QR code of payer's. In addition, user also can change his nickname, password or other information.

There are two type of servers: one is used to manage account information, including payment password, another is used to manage user wallet, which is responsible for handling money transaction. When transferring money, you should provide identification information to the account manager server. If the identification information is incorrect, WeChat will display an error message. Otherwise, the transferring notification will be send to the receiver, and he/she can confirm this transaction to receive the money. However, if the money is not received within 24

hours, the transaction will be expired and money will be returned back to the payer. The payer will be notified in both cases.

Question 3: Draw a sequence diagram representing the process of transferring money to your contacts. Notice that the wallet managing server won't allow you to spend more money than what you have in your wallet. Can you add more details to the existing diagram to show this?

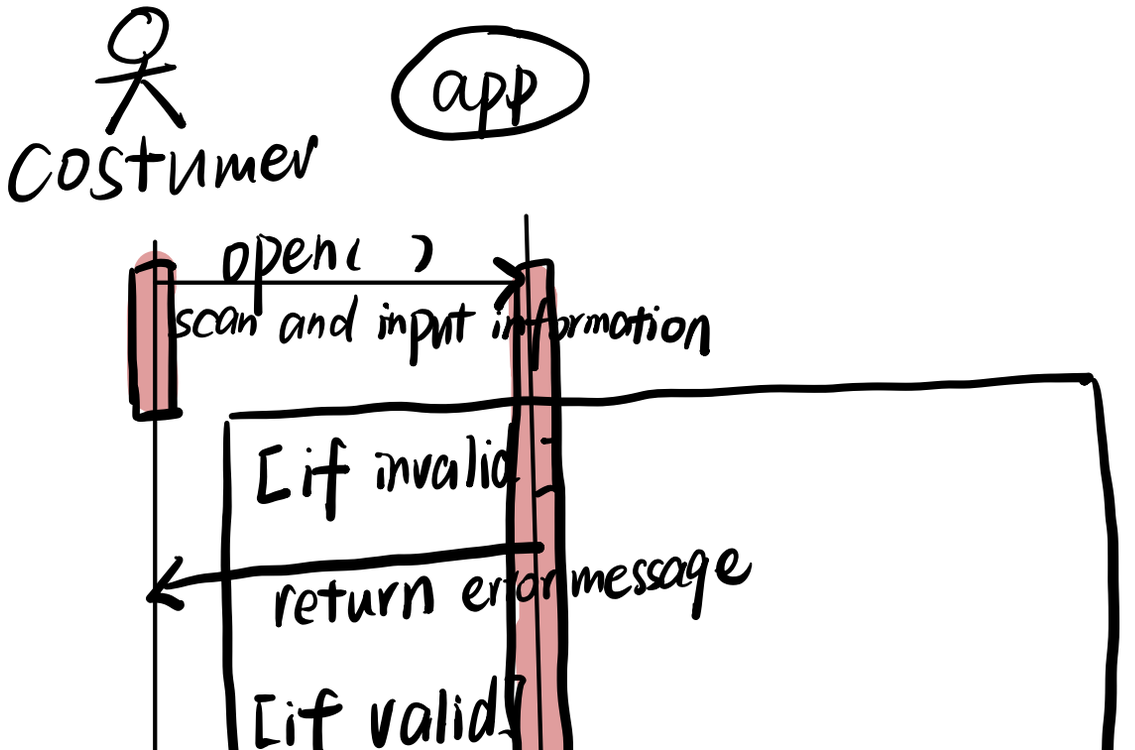
5.2. Parting

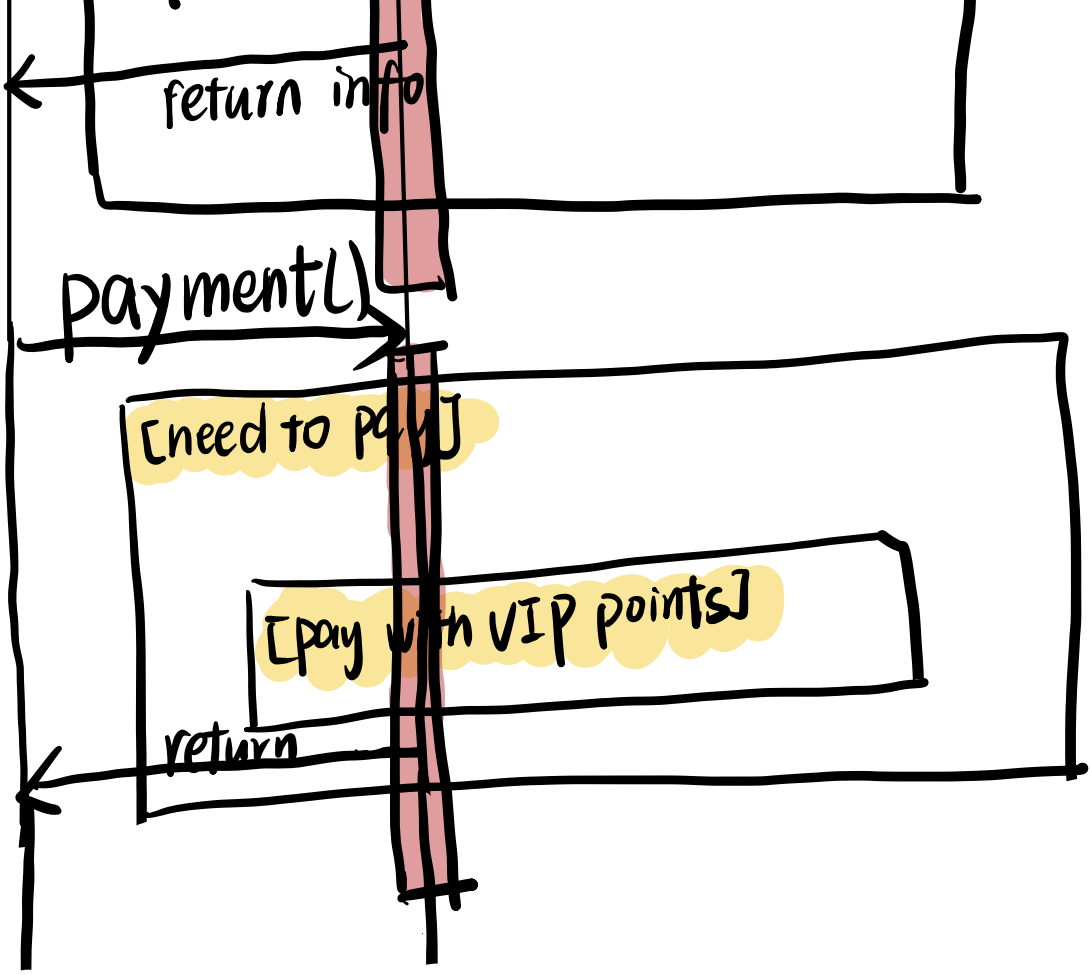
In ShenZhen city, a automatic parking payment system is widely used by almost all shopping malls. Then, it is a time for you to help a newly opened shopping mall design the system. The following description is a simple requirement of the parking management:

Before a car enter the parking lot, there is an automatic scanning device that can register the time and the license plate number of the car. Before leaving, the customer has to pay the parking fee, otherwise he/she cannot drive out of the parking lot. When paying, the customer can pay the parking fees directly, or he/she can choice to deduct the payment with his/her VIP points if he/she is the VIP of this shopping mall. Customers need to drive out of the parking lot within 30 minutes after the successful payment time, otherwise, the cost will be recalculated. There are several administrators who can view the parking list, and they can also query and modify the parking info of each car. On the other hand, in order to promote sales, the shopping mall set a VIP Day on the 1st day of each month. On the 12:00 am in each VIP Day, the system could send points in each VIP account automatically.

Scenario of Payment
Before the payment, customer needs to open the app by scanning a QR code first, and then input the license plate number. If the number is valid, the app can return the parking information about the parking time and how much it will cost otherwise return a error prompt message. If the costumer need to pay the parking fees, he/she can click the payment button to accomplish the payment process. In the process, if the costumer has a VIP account of the shopping mall, he/she can use the VIP points to deduct all or some of the parking fee. After successful payment, an successful message needs to be displayed in the screen and prompt costumer to leave in 30 minutes.

Question 3: Draw a sequence diagram representing the process of payment.




return info
payment()
[need to pay]
[pay with VIP points]
return