课程大纲

九章算法

- 什么是OOD
- 这门课是否适合我
- OOD面试当中的陷阱
- 如何评判OOD面试的好坏
- 5C解题法
- 实战演练：Design elevator system
- 后续课程介绍

OOD vs. System Design

九章算法

	Object Oriented Design	System Design
面试者		
出题目的		
常见公司		
关键字		
例题		

面向对象设计入门

文泰来 老师

OOD介绍

九章算法

- OOD vs. System Design
- OOA vs. OOD vs. OOP
- 面试频率
- 面试当中的重要性
- OOD介绍小结

OOD vs. System Design

九章算法

	Object Oriented Design	System Design
面试者	应届毕业生，SDE I -	有经验的面试者， SDE I +
出题目的	OOD常被当做考察面试者综合素质的标准	需要处理大量数据，提供Service的部门
常见公司		
关键字		
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常见公司	Amazon, Bloomberg,...	Facebook, Google,...
关键字	Viability	Scalability
例题		

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例题		

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OOA vs. OOD vs. OOP

- OOA (Analysis)： 面向对象分析
- OOD (Design)： 面向对象设计
- OOP (Programming)： 面向对象编程

OOD和面试

These questions are not so much about regurgitating design patterns as they are about demonstrating that you understand how to create elegant, maintainable object-oriented code. Poor performance on this type of question may raise serious red flags.

- 面试频率：
  - Phone interview 低
  - Onsite interview 中高频
- 高频公司：
  - Amazon, Bloomberg, TripAdvisor, EMC, Uber…

OOD vs. System Design

	Object Oriented Design	System Design
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关键字	Viability	Scalability
例题	Design Elevator System	Design Twitter

OOD和面试

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OOD介绍小结

OOD在面试当中很重要

- 尤其对于Intern和Entry level

OOD介绍小结

OOD在面试当中很重要

- 尤其对于Intern和Entry level

题目没有标准答案

- Everything is an object

题目类型明显，可用固定的模板解题

OOD和面试

- 出题问法
  - Can you design an elevator system? (设计一个完整的系统)
    - Little amount of coding
  - Can you design scheduler for elevator system? (设计系统中的一个部分)
    - Need implementation

OOD介绍小结

OOD在面试当中很重要

- 尤其对于Intern和Entry level

题目没有标准答案

- Everything is an object

课程要求

- Coding skill
  - Java entry level，有基本的Java知识，了解基本的data structure如Array, List, HashMap等
- Design pattern
  - 不需要design pattern的基础，我们将会在课程中讲解如何运用常见的design pattern来为面试加分

OOD面试中的陷阱

- 起手式的陷阱
- 解题中的陷阱
- 收手式的陷阱

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- Time commitment
  - 每节课时2小时，一周两节课，一共五节课10小时
  - Lintcode 做题，每周一小时

起手式的陷阱

- 指鹿为马

例子:

Let's say you need to support 5000 people to park in this parking lot, morning and night will be your peak hour...

I can try to use this algorithm/data structure to find the closest spot.

忌：Algorithm, OOD, System design 傻傻分不清楚
宜：询问清楚题目要求

收手式的陷阱

- 虎头蛇尾

忌：虎头蛇尾，功亏一篑
宜：检查你的设计，是否能够支持所需的功能

起手式的陷阱

- 先下手为强

例子:

Okay, for a parking lot, we need multiple levels. Also let's make it able to park bicycles.

忌：自说自话，侃侃而谈
宜：先通过和面试官的交流获得有效信息

解题中的陷阱

- 朝出夕改

例子:

Oh, wait a second, I think I can optimize the process by modifying/removing this class

忌：思路混乱，反复修改
宜：先给面试官呈现一个Viable的成果

S.O.L.I.D原则

- S – Single responsibility principle
- O – Open close principle
- L – Liskov substitution principle
- I – Interface segregation principle
- D – Dependency inversion principle

S.O.L.I.D原则

- Single responsibility principle 单一责任原则

一个类应该有且只有一个去改变他的理由，这意味着一个类应该只有一项工作。

```
public class AreaCalculator
{
    private float result;

    public float calculateArea(Shape s)
    {
        //calculates the area for a given shape, store in result
    }

    public String printAreaAccurateToOneDecimalPlace()
    {
        //prints result accurate to one decimal place
    }
}
```


如何评判一轮OOD面试

S.O.L.I.D原则

- Single responsibility principle 单一责任原则

一个类应该有且只有一个去改变他的理由，这意味着一个类应该只有一项工作。

S.O.L.I.D原则

九章算法

- Open close principle 开放封闭原则

对象或实体应该对扩展开放，对修改封闭 (Open to extension, close to modification)。

```
public class AreaCalculator
{

    public float calculateArea(Triangle t)
    {
        //calculates the area for triangle
    }

    public float calculateArea(Rectangle r)
    {
        //calculates the area for rectangle
    }
}
```


S.O.L.I.D原则

九章算法

- Liskov substitution principle 里氏替换原则

任何一个子类或派生类应该可以替换它们的基类或父类

```
public class Shape
{
    abstract public float calculateVolumn();
    abstract public float calculateArea();
}

public class Rectangle extends Shape
{
    //...
}

public class Cube extends Shape
{
    //...
}
```


S.O.L.I.D原则

九章算法

- Open close principle 开放封闭原则

对象或实体应该对扩展开放，对修改封闭 (Open to extension, close to modification)。

S.O.L.I.D原则

九章算法

- Liskov substitution principle 里氏替换原则

任何一个子类或派生类应该可以替换它们的基类或父类

S.O.L.I.D原则

- Interface segregation principle 接口分离原则

不应该强迫一个类实现它用不上的接口

```
public interface Shape
{
    public float calculateVolumn();
    public float calculateArea();
}

public class Rectangle implements Shape
{
    //...
}

public class Cube implements Shape
{
    //...
}
```


S.O.L.I.D原则

- Dependency inversion principle 依赖反转原则

抽象不应该依赖于具体实现，具体实现应该依赖于抽象

```
public class AreaCalculator
{

    public String shape_string;
    public Shape shape;

    public AreaCalculator()
    {
        if(shape_string.equals("Triangle"))
        {
            shape = new Triangle();
        }
        else if(shape_string.equals("Rectangle"))
        {
            shape = new Rectangle();
        }
    }

    public float area()
    {
        return shape.area();
    }
}
```

```
public class AreaCalculator
{

    public float calculateArea(ShapeInterface s)
    {
        //calculates the area for triangle
    }
}

interface ShapeInterface
{
    public float area();
}

public class Rectangle implements ShapeInterface
{
    private float length;
    private float width;

    public float area()
    {
        return length * width;
    }
}

public class Triangle implements ShapeInterface
{
    private float height;
    private float width;

    public float area()
    {
        return (height * width) / 2;
    }
}
```


S.O.L.I.D原则

- Interface segregation principle 接口分离原则

不应该强迫一个类实现它用不上的接口

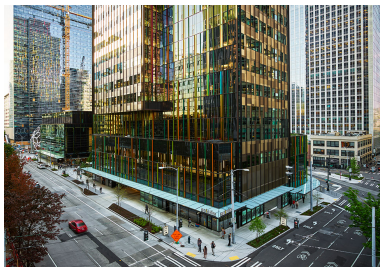
S.O.L.I.D原则

- Dependency inversion principle 依赖反转原则

抽象不应该依赖于具体实现，具体实现应该依赖于抽象

Elevator

- Can you design an elevator system for this building?



奔雷手 - 5C解题法

Clarify
说人话：通过和面试官交流，去除题目中的歧义，确定答题范围

Core objects
说人话：确定题目所涉及的类，以及类之间的映射关系

Cases
说人话：确定题目中所需要实现的场景和功能

Classes
说人话：通过类图的方式，具体填充题目中涉及的类

Correctness
说人话：检查自己的设计，是否满足关键点

面试中应该怎么做？

- 实战演练

奔雷手 - 5C解题法

- Clarify
- Core objects
- Cases
- Classes
- Correctness

Clarify

Example: Glass of water ?

Clarify

Example: Glass of water ?

Clarify

Example: Glass of water ?

Clarify

Example: Glass of water ?

Clarify

- What
- How
- Who

Clarify

关键字1：Elevator

属性？

Clarify

Example: Glass of water ?

Clarify

- What

针对题目中的关键字来提问，帮助自己更好的确定答题范围。

*大多数的关键字为名词，通过名词的属性来考虑

Clarify

关键字1：Elevator

- 没有电梯厢
- 每层楼之间不同

Clarify

关键字1：Elevator

针对本题：所有电梯厢均为相同规格

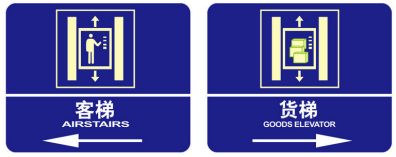
Clarify

关键字1：Elevator

- 可能需要考虑获取每辆电梯的目前重量

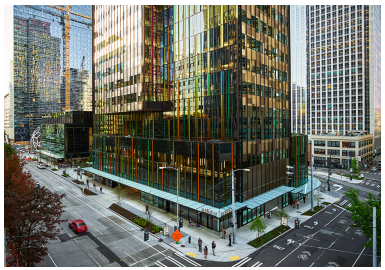
Clarify

关键字1：Elevator



- 是否需要设计两种类，如果需要它们之间是什么关系？
- 客梯和货梯有什么区别？

关键字2：Building



楼有多大/楼有多高/楼内能容纳多少人？

- 通用属性，对于题目帮助不大

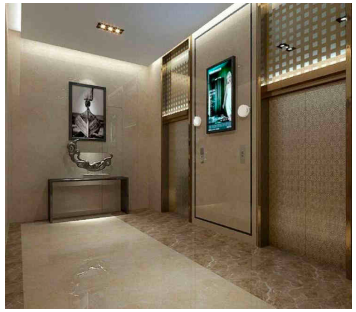
关键字2：Building

针对本题：每层仅一处能搭乘，所有电梯均可响应

关键字2：Building

属性？

关键字2：Building



是否有多处能搭乘的电梯口？

- 当收到一个搭乘电梯的请求时，有多少电梯能够响应？

Clarify

电梯有哪些规则？

Clarify

当电梯在运行时，哪些按键可以响应？

- 是否能按下反向的楼层

Clarify

- How

针对问题主题的规则来提问，帮助自己明确解题方向。

*此类问题没有标准答案，你可以提出一些解决方法，通过面试官的反应，选择一个你比较有信心（简单）的方案

Clarify

当按下按钮时，哪一台电梯会相应？

- 同方向 > 静止 > 反向
- 一半负责奇数楼层，一半负责偶数楼层
- ...

Clarify

- Who

设计由人主导 VS. 设计由系统主导？

Clarify

- Who

Optional, 通过思考题目当中是否有人的出现，来帮助确定解题范围

*一般可以考虑人的角色以及人的属性，看是否题目需要

Clarify

规则：

对于本题：同向 > 静止 > 反向，当运行时不能按下反向的楼层

信息：电梯至少需要三种状态，并且要知道当前在哪一层

Clarify

- Who

设计由人主导 VS. 设计由系统主导？

Clarify

电梯系统如何获取每位乘客的重量？

- Passenger class包含重量
- 电梯能够自动感应当前重量

Core Object

- 什么是Core Object
- 为什么要定义Core Object？
- 如何定义Core Object？

Clarify

人物属性？

Clarify

对于本题：

电梯能够获取当前重量

Core Object

- 为什么要定义Core Object？

- 这是和面试官初步的纸面contract
- 承上启下，来自于Clarify的结果，成为Use case的依据
- 为画类图打下基础

Core Object

- 如何定义Core Object？

ElevatorSystem

Core Object

- 什么是Core Object

为了完成设计，需要哪些类？

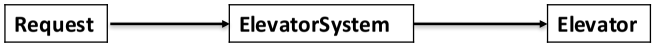
Core Object

- 如何定义Core Object？

- 以一个Object作为基础，线性思考
- 确定Objects之间的映射关系

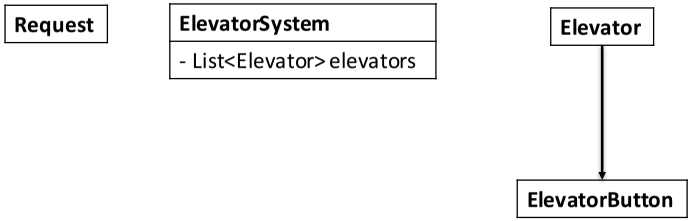
Core Object

- 如何定义Core Object？



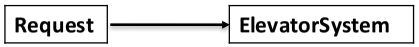
Core Object

- 如何定义Core Object？



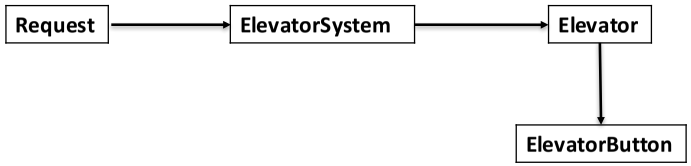
Core Object

- 如何定义Core Object？



Core Object

- 如何定义Core Object？



Good Practice

- Access modifier

- package
- public
- private
- protected

Good Practice

- public

如果声明为public，变量和函数都是public level visible的，任何其他的类都可以访问

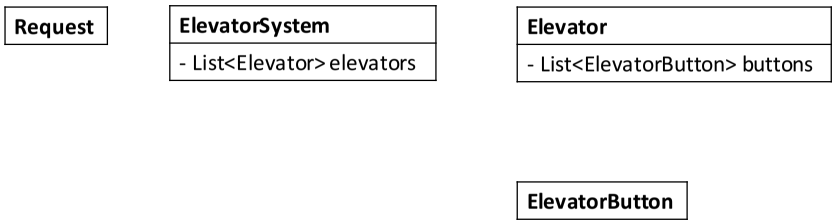
Example:

```
public static void main(String[] arguments)
{
    //...
}
```

在类图中，用"+"表示一个变量或者函数为public

Core Object

- 如何定义Core Object？



Good Practice

- package

如果什么都不声明，变量和函数都是package level visible的，在同一个package内的其他类都可以访问

Example:

```
String input = "test";

void printInput()
{
    System.out.println(input);
}
```

在类图中，避免使用default的package level access

Good Practice

- protected

如果声明为protected，变量和函数在能被定义他们的类访问的基础上，还能够被该类的子类所访问。

protected也是OOD当中实现继承的重要手段。

Example:

```
class AudioPlayer
{
    protected Speaker speaker;
}

class StreamingAudioPlayer extends AudioPlayer
{
    public void openSpeaker()
    {
        speaker.open();
    }
}
```

在类图中，用"#"表示一个变量或者函数为protected

Cases

- 什么是Use case ？

在你设计的系统中，需要支持哪些功能？

Good Practice

- private

如果声明为private，变量和函数都是class level visible的，这是所有access modifier中限制最多的一个。仅有定义这些变量和函数的类自己可以访问。

private也是OOD当中实现封装的重要手段。

Example:

```
public class AreaCalculator()
{
    private Logger log;
}
```

在类图中，用"-"表示一个变量或者函数为private

Cases

- 什么是Use case ？
- 为什么要写Use cases ？
- 如何写Use cases ？

Cases

- 怎么写Use cases ?

- 利用定义的Core Object, 列举出每个Object对应产生的use case.
- 每个use case只需要先用一句简单的话来描述即可

Cases

- ElevatorSystem

- Handle request

Cases

- 为什么要写Use cases ?

- 这是你和面试官白纸黑字达成的第二份共识，把你将要实现的功能列在白板上
- 帮助你在解题过程中，理清条例，一个一个Case实现
- 作为检查的标准

Cases

- ElevatorSystem

Cases

- Elevator

Cases

- Elevator

- Take external request
- Take internal request

Cases

- Request

N/A

Cases

- Elevator

- Take external request

Cases

- Elevator

- Take external request
- Take internal request
- Open gate
- Close gate

Cases

- Elevator

- Take external request
- Take internal request
- Open gate
- Close gate
- Check weight

What about single responsibility principle?

Cases

- Elevator

- Take external request
- Take internal request
- Open gate

Cases

- Elevator

- Take external request
- Take internal request
- Open gate
- Close gate
- Check weight

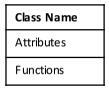
Cases

- ElevatorButton

- Press button

Class

- Class diagram (类图)



Cases

- ElevatorButton

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Class

- 什么是类图？
- 为什么要画类图？
- 怎么画类图？

Class

- 怎么画类图？

- 遍历你所列出的use cases
- 对于每一个use case，更加详细的描述这个use case在做什么事情（例如：take external request -> ElevatorSystem takes an external request, and decide to push this request to an appropriate elevator）
- 针对这个描述，在已有的Core objects里填充进所需要的信息

Class

- Use case: Handle request

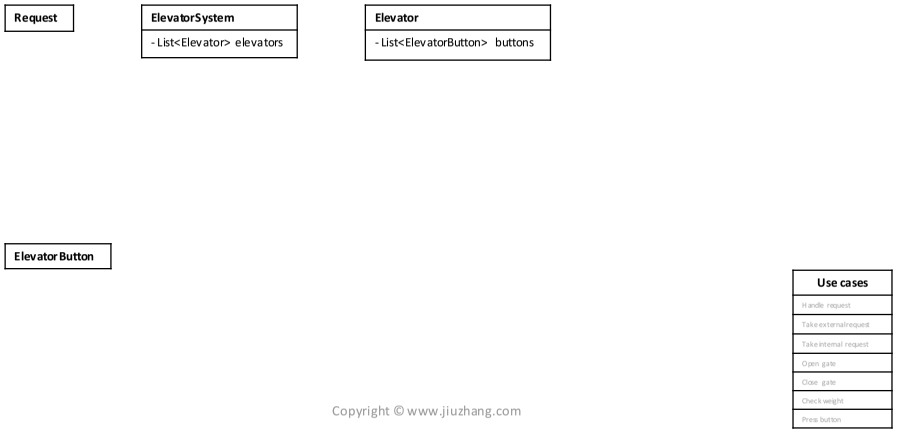
ElevatorSystem takes an **external request**, and decide to push this request to an appropriate **elevator**

Class

- 为什么要画类图？

- 可交付，Minimal Viable Product
- 节省时间，不容易在Coding上挣扎
- 建立在Use case上，和之前的步骤层层递进，条例清晰，便于交流和修改
- 如果时间允许/面试官要求，便于转化成Code

Class



Good Practice

- 如何知道一个函数，是否成功完成任务？

地下一层电梯关闭，这时有人在地下一层按了向上的按钮，会发生什么？

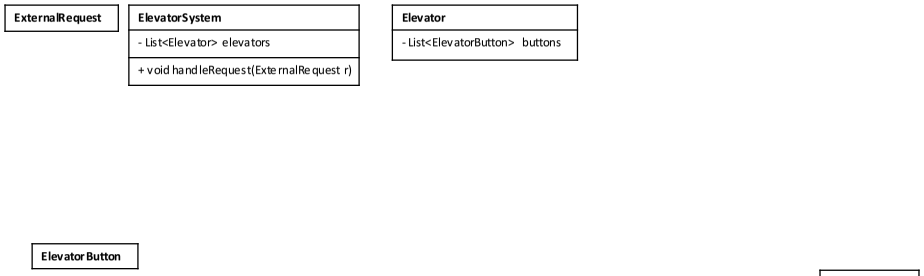
Good Practice

- 如何知道一个函数，是否成功完成任务？

- Use boolean instead of void
成功的话返回true, 否则返回false

- 如何知道是什么地方出错？

Class



Good Practice

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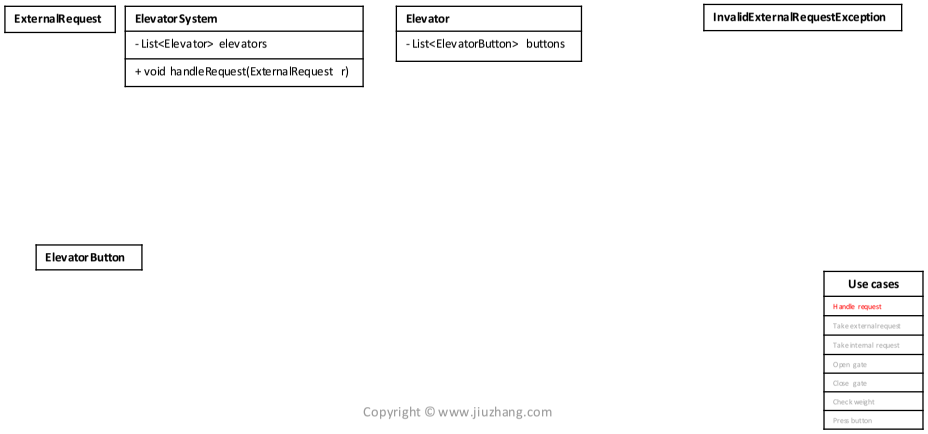
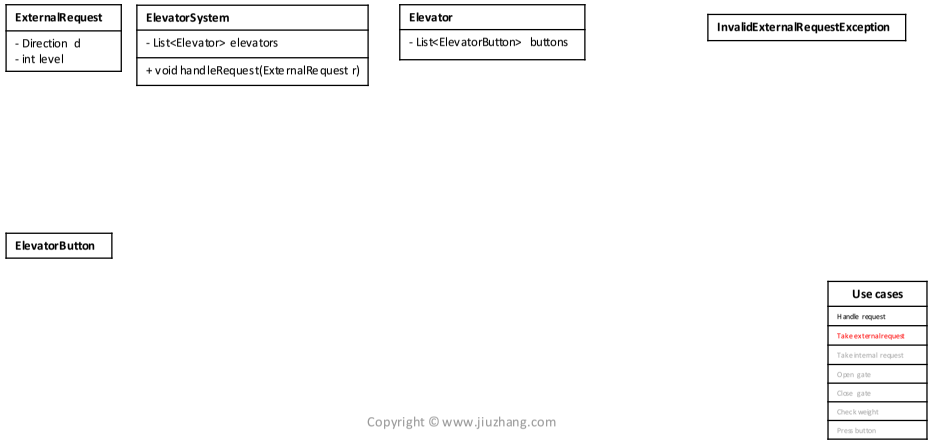
- Use boolean instead of void
成功的话返回true, 否则返回false

Class



Class



Good Practice

- 如何知道一个函数，是否成功完成任务？

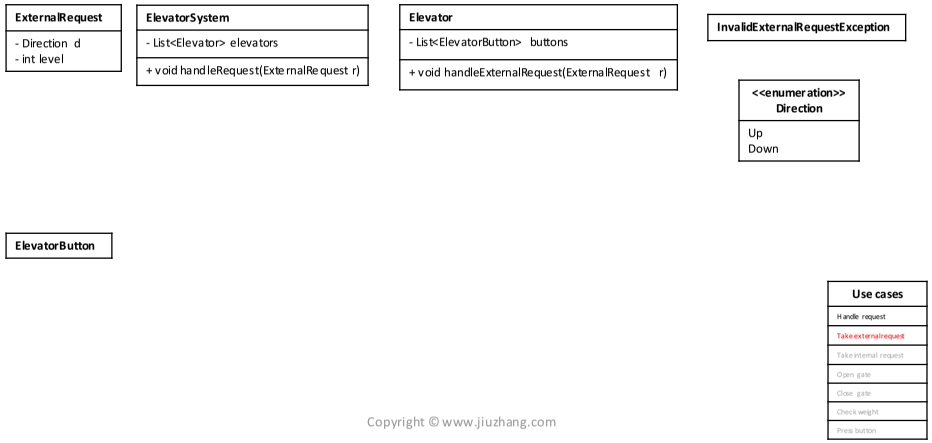
- Use exceptions

Class

- Use case: Take external request

An **elevator** takes an external **request**, inserts in its stop list.

Class



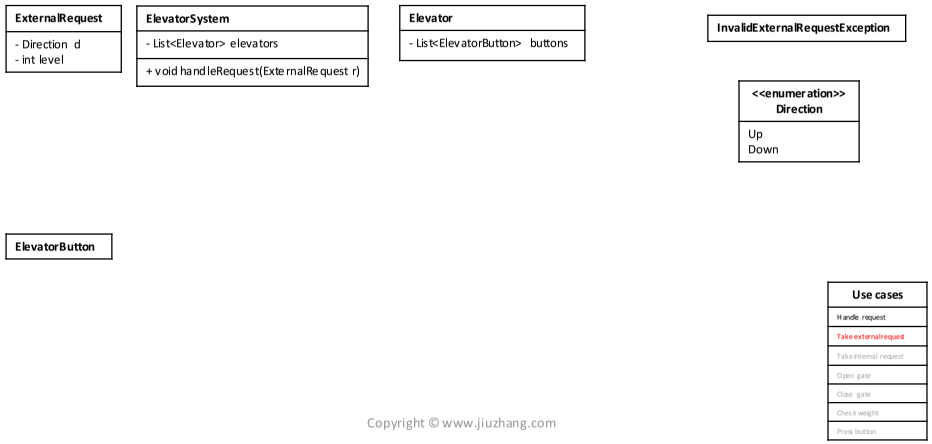
Challenge

- 如果电梯目前在1L，有人按下了5L向上，之后又有人按下了3L向上，电梯会怎样行动？

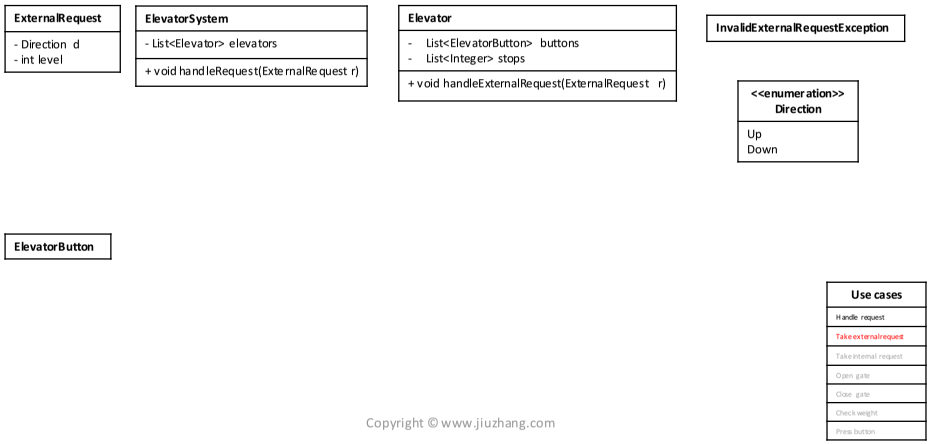
stops will be {5,3}

Expected is: {3,5}

Class



Class



Challenge

- 如果电梯目前在1L，有人按下了5L向上，之后又有人按下了3L向上，电梯会怎样行动？

stops will be {5,3}

Expected is: {3,5}

Solution2: use priority queue instead of list

Challenge

- 如果电梯目前在1L，有人按下了5L向上，之后又有人按下了3L向上，紧接着这台电梯又被分配了一个2L向下的request。这台电梯会如何行动？

stops will be {2，3，5}

Expected is: {3，5，2}

Solution: keep 2 lists for different direction

Challenge

- 如果电梯目前在1L，有人按下了5L向上，之后又有人按下了3L向上，电梯会怎样行动？

stops will be {5,3}

Expected is: {3,5}

Solution1: sort stops every time we add to it.

Challenge

- 如果电梯目前在1L，有人按下了5L向上，之后又有人按下了3L向上，紧接着这台电梯又被分配了一个2L向下的request。这台电梯会如何行动？

stops will be {2，3，5}

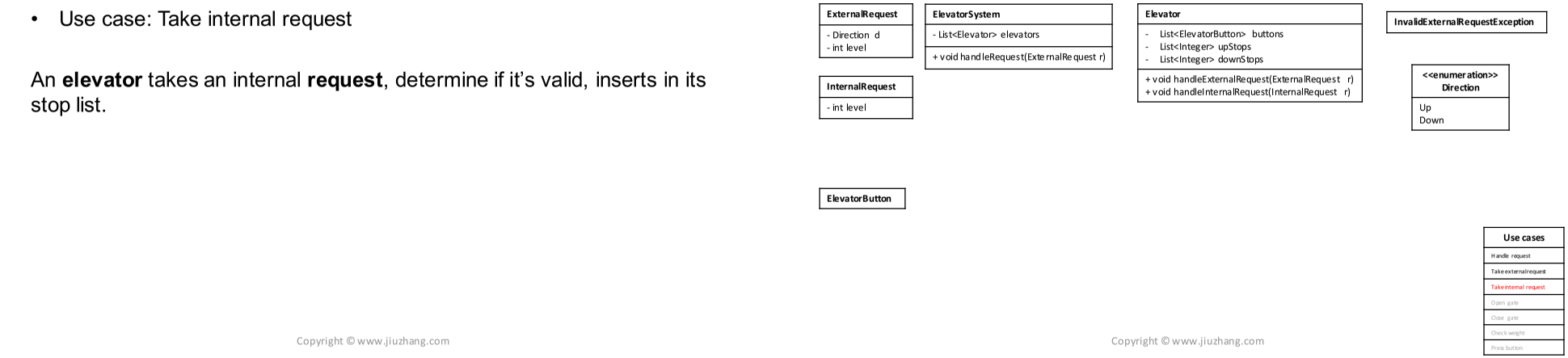
Expected is: {3，5，2}

Class

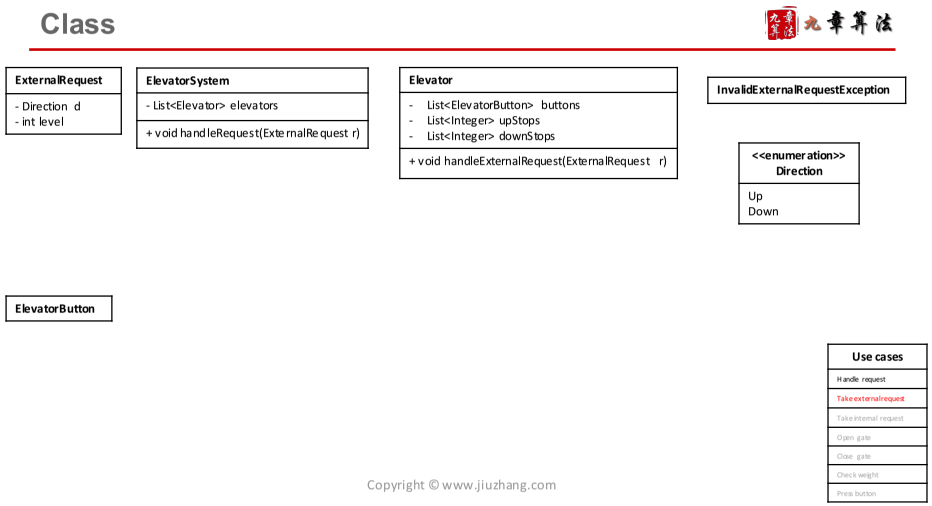
- Use case: Take internal request

An **elevator** takes an internal **request**, determine if it's valid, inserts in its stop list.

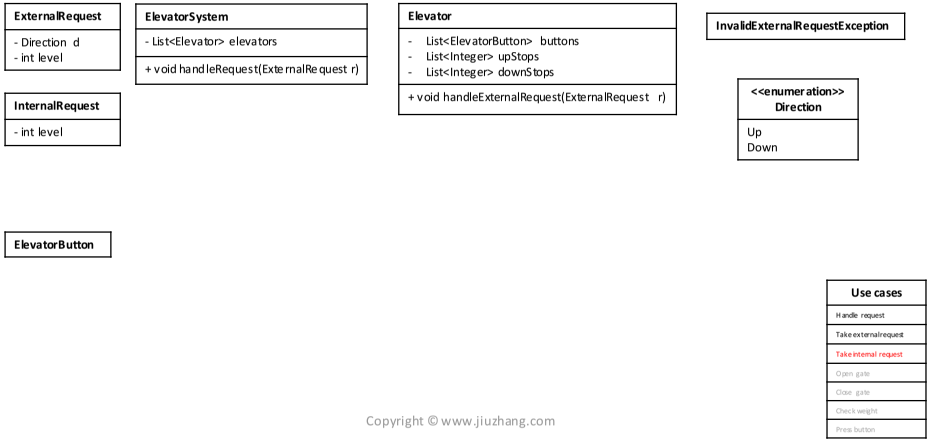
Class



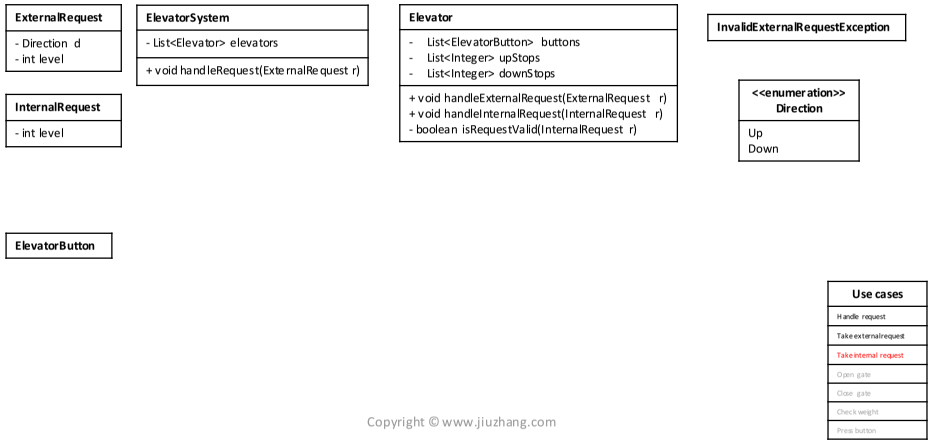
Class



Class



Class



Challenge

- 如何判断一个Internal request 是否为Valid?

Solution:

If elevator going up

requested level lower than current level

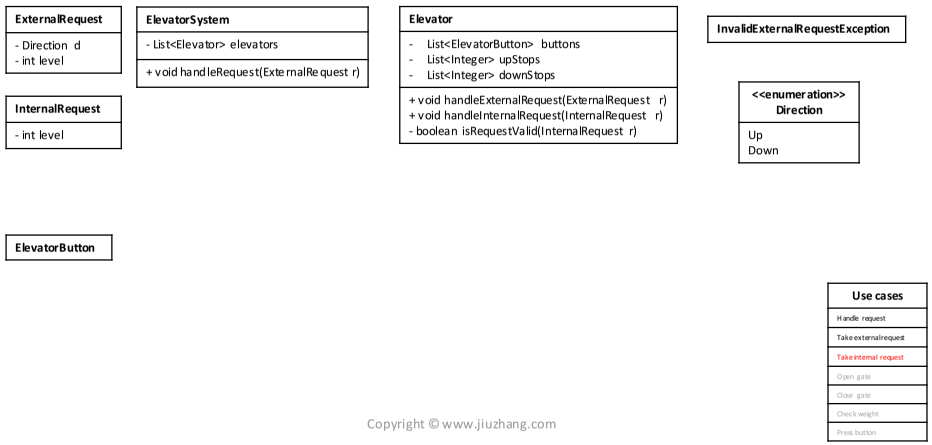
invalid

If elevator going down

requested level higher than current level

invalid

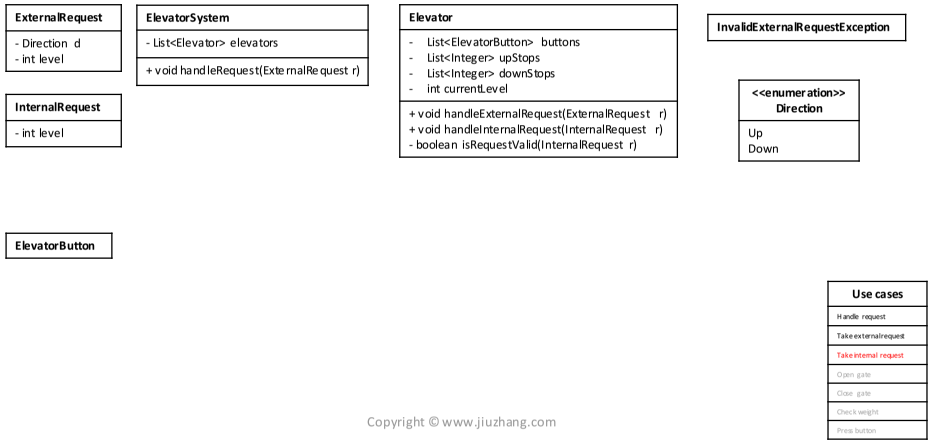
Class



Challenge

- 如何判断一个Internal request 是否为Valid?

Class



Class

- Use case: Open gate

An **elevator** reaches the destination level, open gate

Challenge

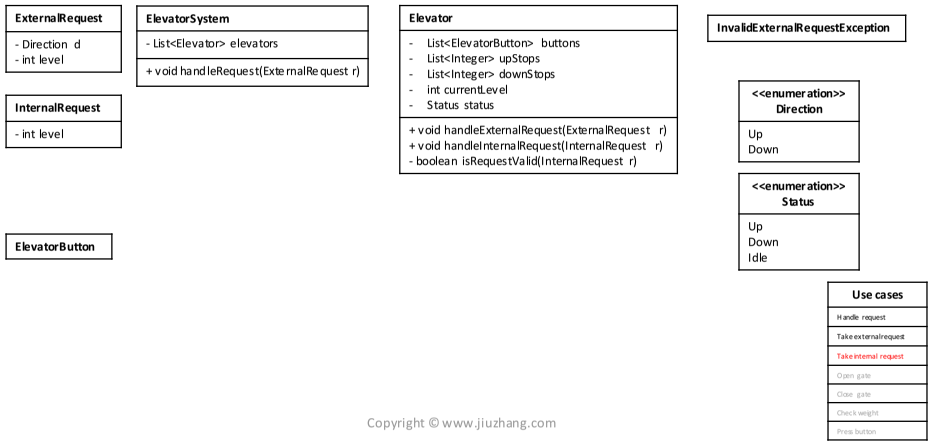
- 如何判断一个Internal request 是否为Valid?

Solution:

If elevator **going up**
requested level lower than **current level**
invalid

If elevator **going down**
requested level higher than **current level**
invalid

Class

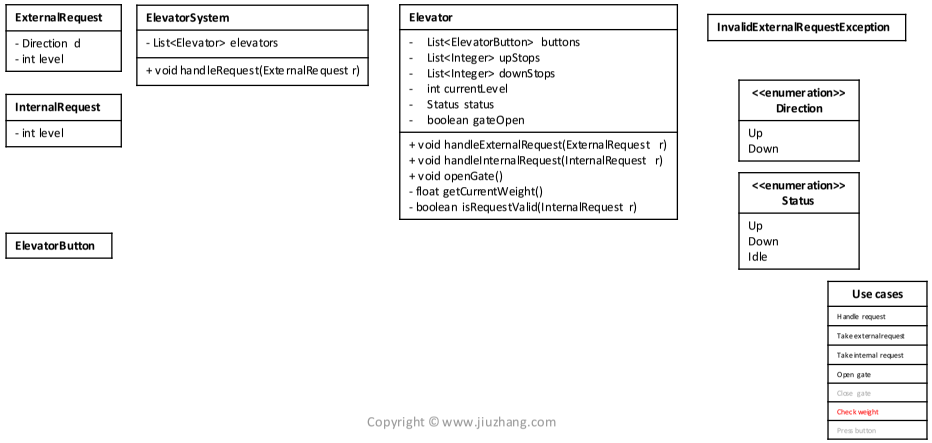


Class

- Use case: Close gate

An **elevator**
checks if overweight;
close the door;
then check stops corresponds to current status;
if no stops left, check the reserve direction stops;
change status to reserve direction or idle.

Class



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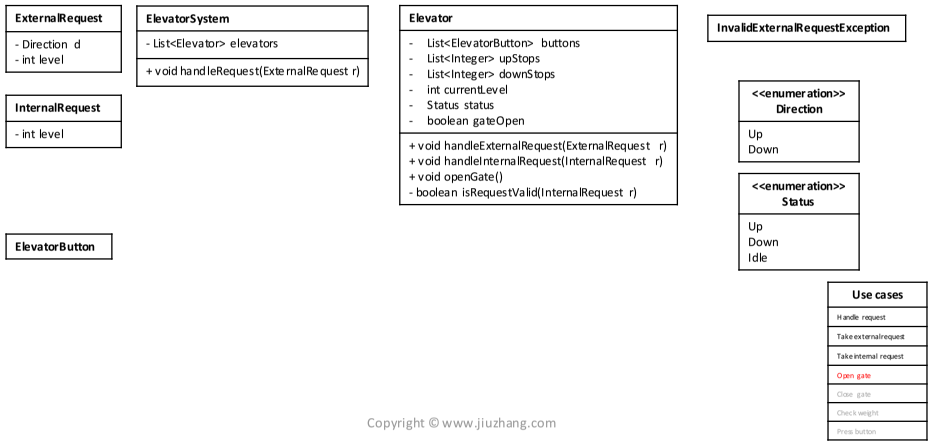
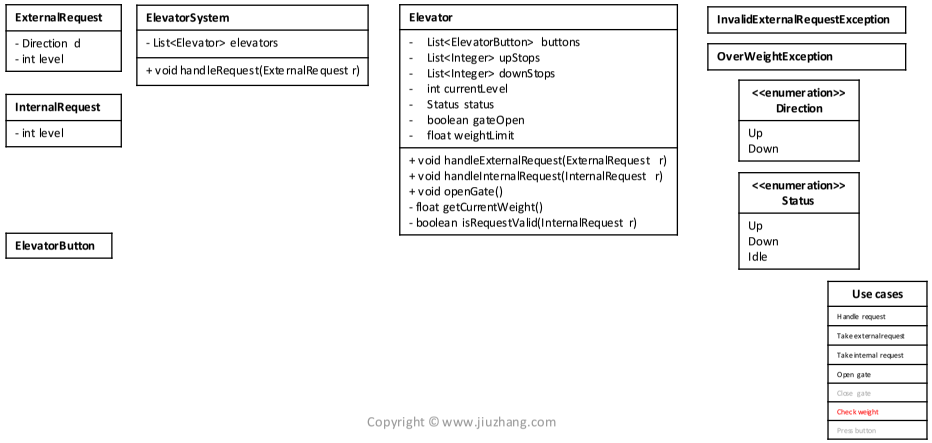


Class

- Use case: check weight

An **elevator** checks its **current weight** and compare with **limit** to see if overweight

Class

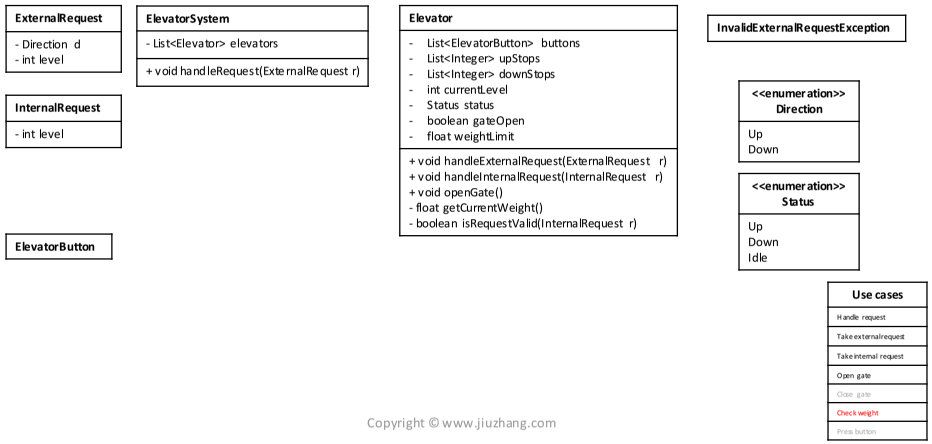


Class

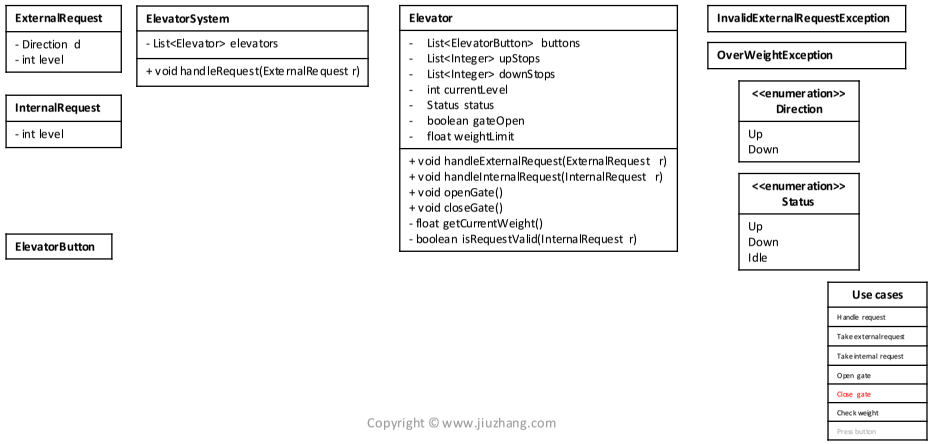
- Use case: press button

A **button** inside elevator is pressed, will generate an **internal request** and send to the **elevator**.

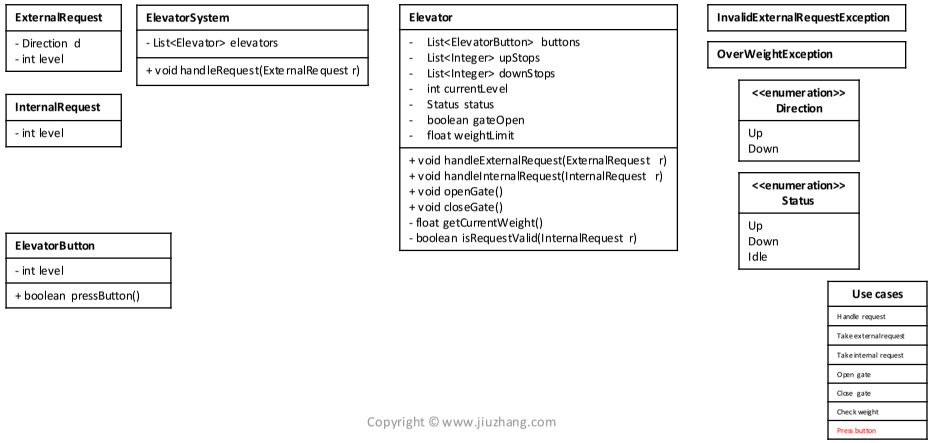
Class



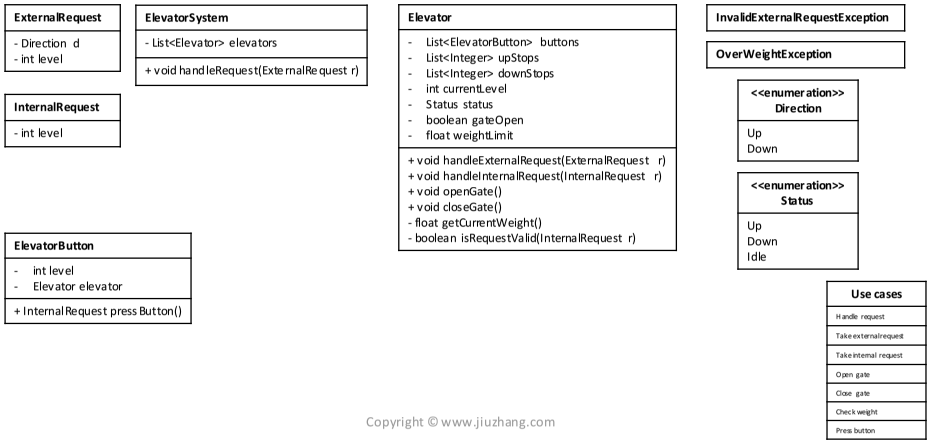
Class



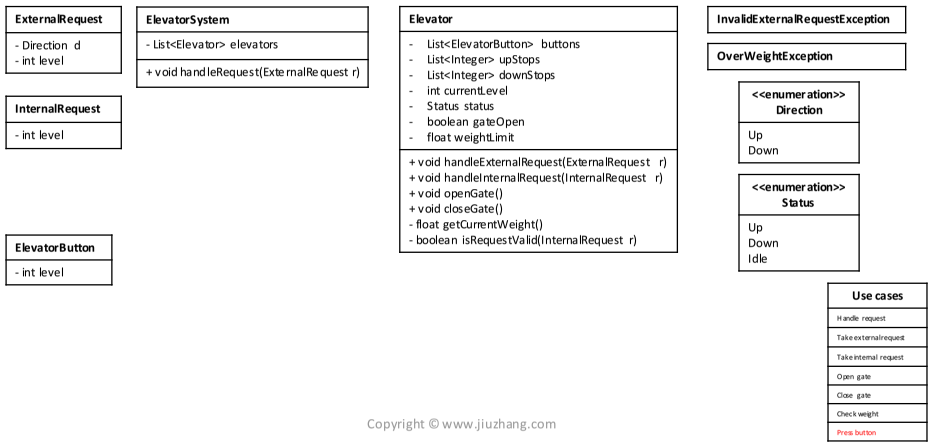
Class



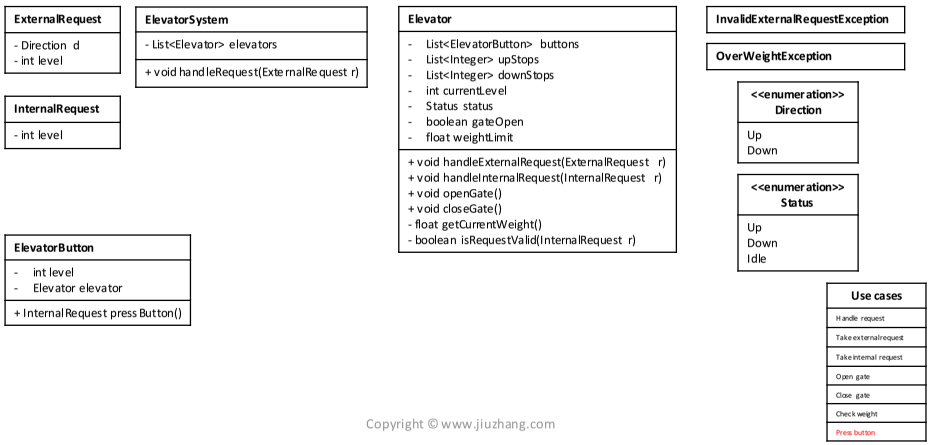
Class – Final view



Class



Class



Good Practice

- 继承

检查你的设计中，是否有重复的类，可以采用继承的方式来表现

Challenge

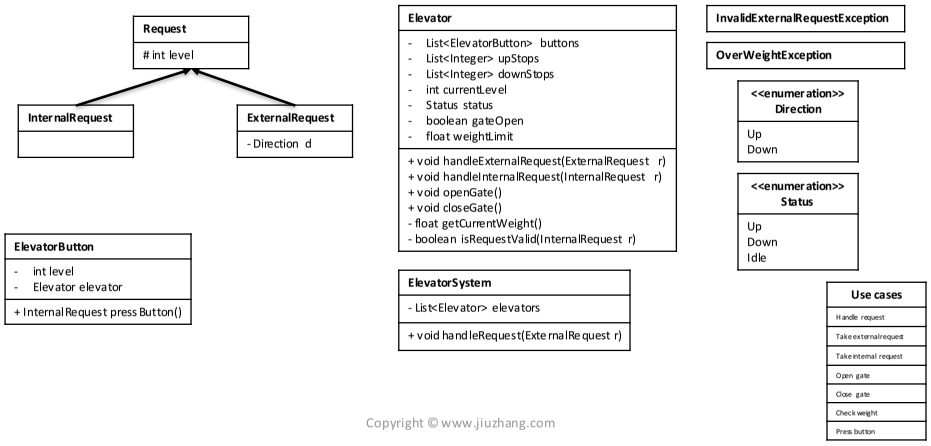
- How do you handle an external request?
- What if I want to apply different ways to handle external requests during different time of a day?
- Can you implement it in code?

Correctness

- 从以下几方面检查：

- Validate use cases (检查是否支持所有的use case)
- Follow good practice (面试当中的加分项，展现一个程序员的经验)
- S.O.L.I.D
- Design pattern

Good Practice



Challenge

- What if I want to apply different ways to handle external requests during different time of a day?

Challenge

- What if I want to apply different ways to handle external requests during different time of a day?

Solution 2: Strategy design pattern

Challenge

- How do you handle an external request?

如我们最早和面试官讨论的结果：

同方向 > 静止 > 反向

Challenge

- What if I want to apply different ways to handle external requests during different time of a day?

- Solution 1: if - else

```
public void handleRequest(ExternalRequest r)
{
    if(time == TIME.PEAK)
    {
        // use peak hour handler
    }

    else if(time == TIME.NORMAL)
    {
        // use normal hour handler
    }
}
```

Recap

- 什么是OOD
- SOLID原则

Recap

- 什么是OOD
- SOLID原则
- 5C 解题法
- Good practice: Access modifier

Recap

- 什么是OOD

Recap

- 什么是OOD
- SOLID原则
- 5C 解题法

Recap

- 什么是OOD
- SOLID原则
- 5C 解题法
- Good practice: Access modifier
- Good practice: Exception
- Design pattern: Strategy

Next...

第3章 预定类面向对象设计 OOD for Reservation System

本节大纲

- 预定类面试题型特点分析
- 实战面试真题：
  - 酒店预订系统设计 Hotel Reservation
  - 航空机票预订系统设计 Airline Ticket Reservation

Recap

- 什么是OOD
- SOLID原则
- 5C 解题法
- Good practice: Access modifier
- Good practice: Exception

Next...

第2章 管理类面向对象设计 OOD for Management System

本节大纲

- 管理类 OOD 面试题型特点分析
- 实战OOD面试真题：
  - 停车场问题 Parking lot
  - 餐厅管理问题 Restaurant
- 设计模式讲解 Design Pattern: Singleton

Next...

九章算法

第5章 游戏棋牌类面向对象设计 OOD for Games

本节大纲

- 棋牌游戏类面试题型特点分析
- 棋牌游戏类面试题特殊技巧讲解
- 实战面试真题：
  - Black Jack
  - Chinese chess
- 课程总结及面试技巧点拨

Next...

九章算法

第4章 实物类面向对象设计 OOD for Real Life Object

本节大纲

- 实物类面试题型特点分析
- 实战面试真题：
  - Vending machine
  - Juke box
- 设计模式讲解 Design Pattern: Factory
- 设计模式讲解 Design Pattern: Adaptor

Q & A

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