

OOP with Java

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OOP with Java

- 通知
 - Project 4: 5月2日晚9点

- 复习

- Java 包

- 创建包 : `package` 语句 , 包结构与目录结构一致
 - 使用包 : `import`

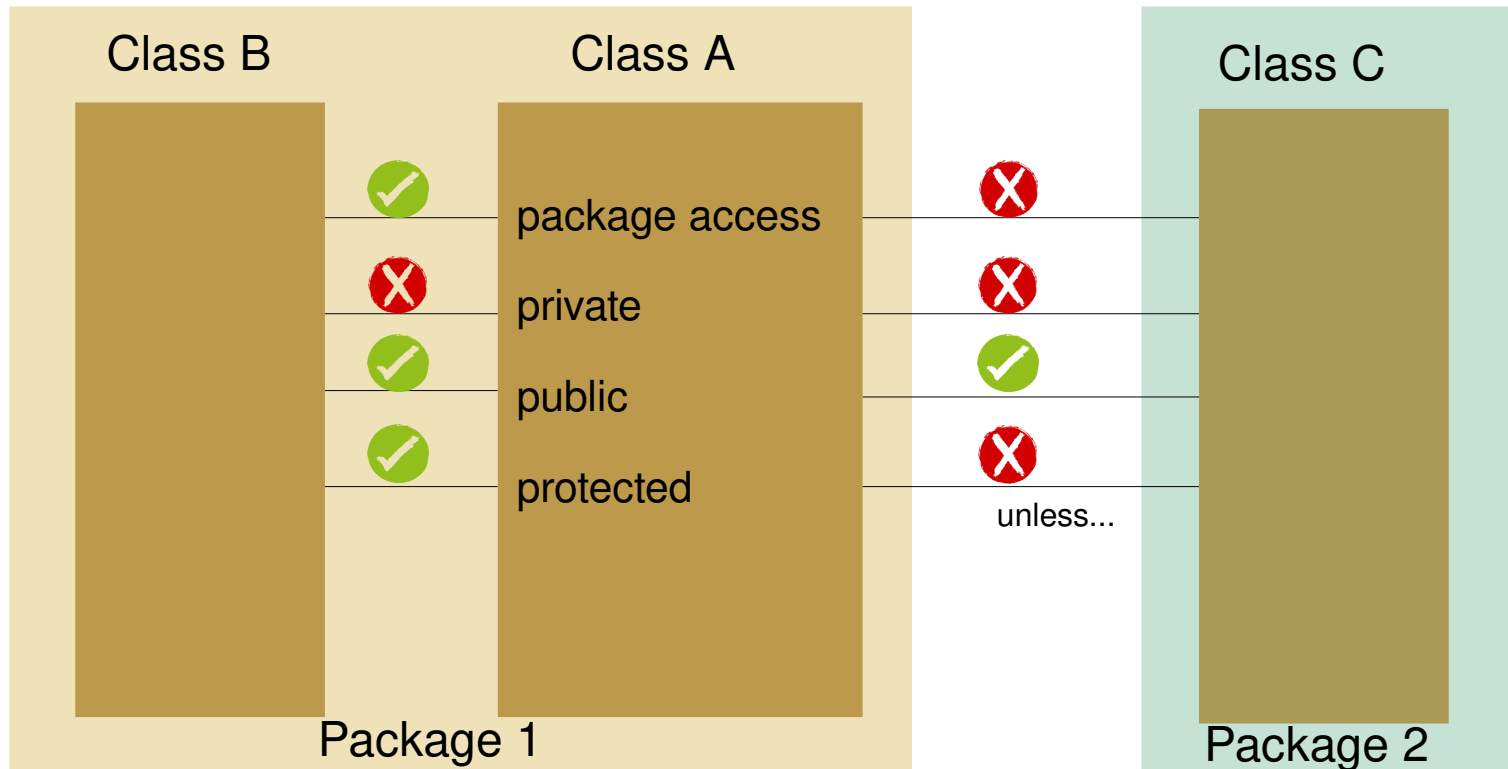
```
restaurant/  
- people/  
  - Cook.class  
  - Waiter.class  
- tools/  
  - Fork.class  
  - Table.class
```

```
import restaurant.people.Cook;  
import restaurant.tools.Fork;  
import restaurant.tools.*;  
import restaurant.*;
```

• 复习

- 访问控制

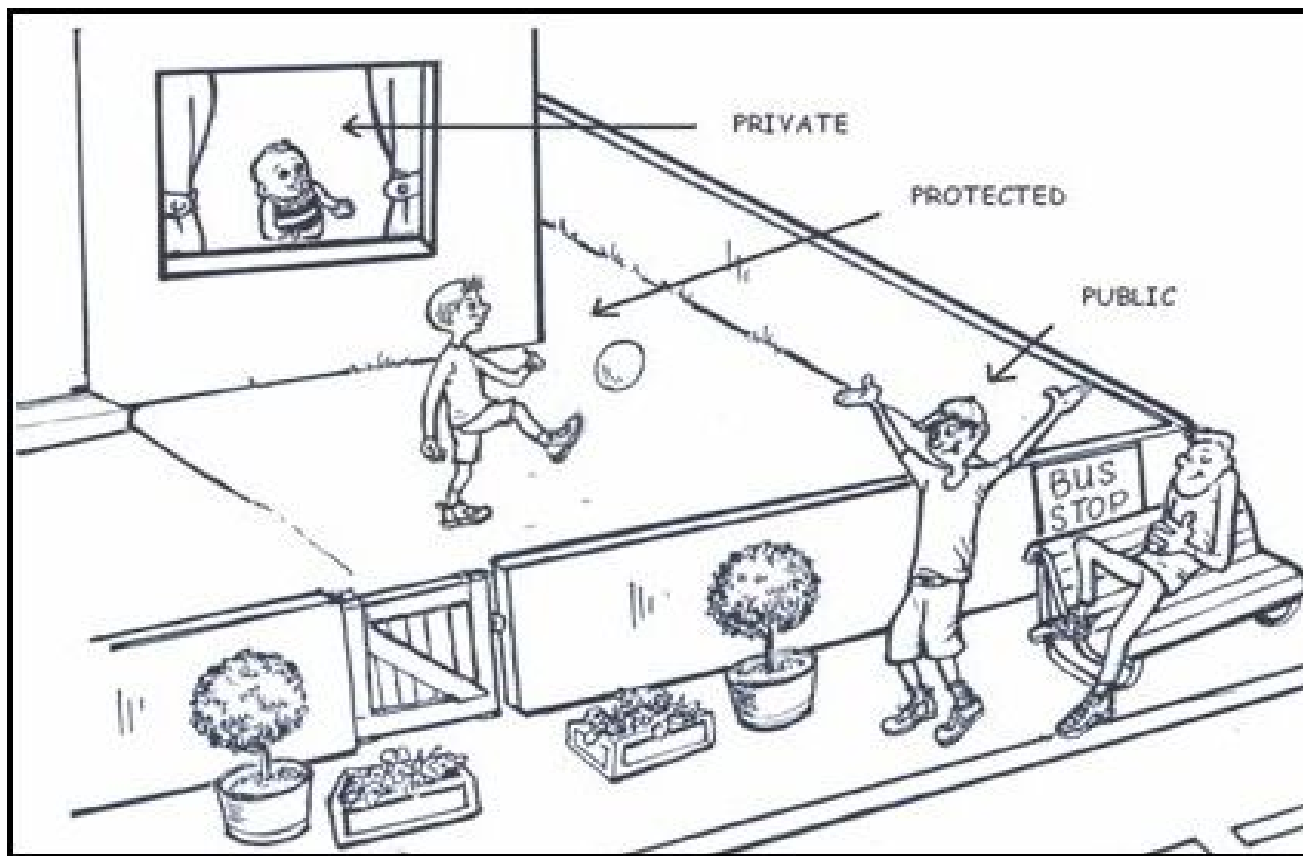
- 对类的成员 (数据 , 方法) 的一种修饰
- 对哪些外部对象是可见的 ?
- package access (default package), public, private, protected



- 复习

- 为什么需要访问控制？封装

- 将易变的与稳定的部分区分开
 - 在满足需求的情况下，接口尽量简单



OOP with Java

- 类的复用
- 组合
- 继承
- 组合与继承

类的复用

- 类的复用 (reuse classes)
 - 问题：如何通过已有类来定义新的类
 - 已有类 A, 创建类 B
 - B 有部分功能与 A **重合**
 - 例子
 - 已有 Car 类, 创建 Transformer 类？



类的复用

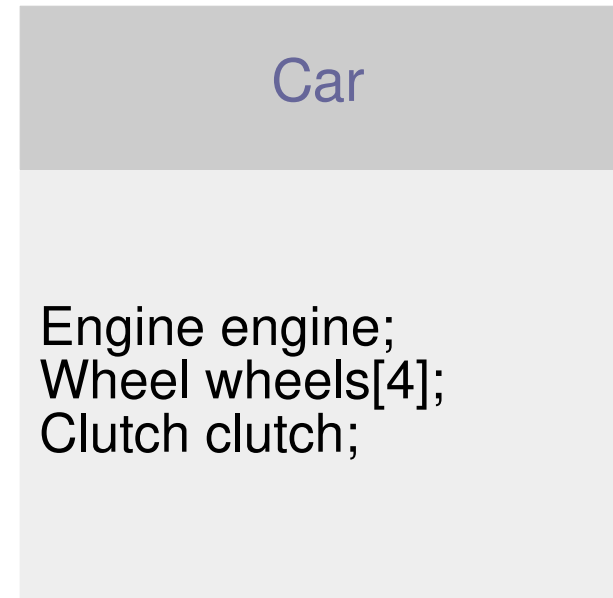
Copy and Paste

```
class A {  
    // data  
    // ...  
  
    // methods  
    //...  
}
```

```
class B {  
    // data of A  
    // ...  
  
    // methods of A  
    // ...  
  
    // new things  
}
```


类的复用

- 情况 1
 - class B 中包含 class A 类型的数据成员
 - 例如：
 - 引擎类 : class Engine
 - 轮胎类 : class Wheel
 - 离合器类 : class Clutch
 - 汽车类 ?
 - “has-a” 关系



组合 (composition)

类的复用

- 情况 2

- class B 带有 class A 所有的数据和方法成员，同时增加新的成员，或者修改原有的成员

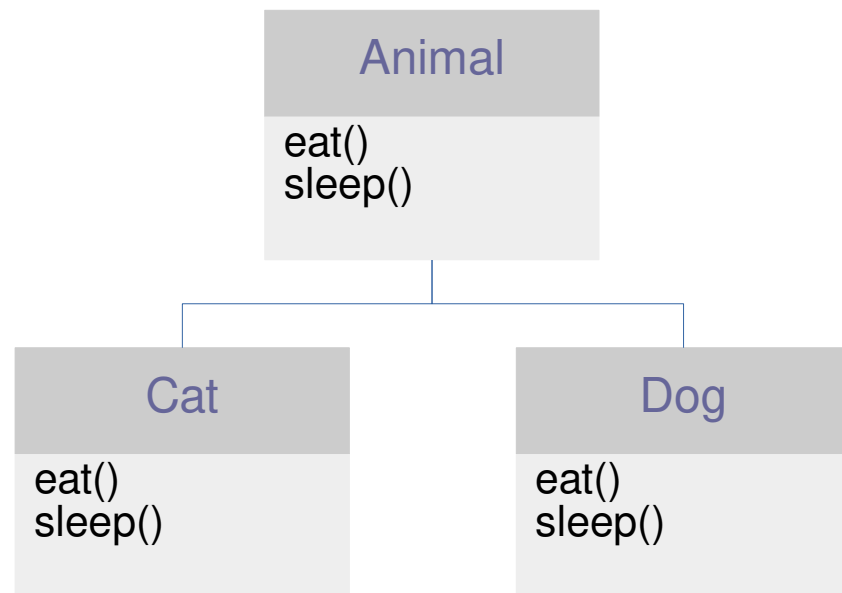
- 例如：

- 跑车类具有汽车类的所有方法

- “is-a” 关系

- A cat is an animal

- A dog is an animal



继承 (Inheritance)

类的复用

- 重复使用已有类的两种方式
 - 组合 (composition)
 - 继承 (inheritance)

组合

- 将已有类的对象作为新类的数据成员

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
}
```

```
public class MyCompType {  
    private MyType m = new MyType();  
    private String s;  
    public MyCompType(){  
        s = new String("Hello");  
    }  
}
```

组合

- 初始化 (复习)
 - 默认初始化 (null)
 - 定义时初始化
 - 构造函数初始化
 - 用时初始化
 - 当需要使用该成员时再初始化

组合

- 一种常见的重用方式
- 广义的说，**MyType** 类可视为对基本类型的重用

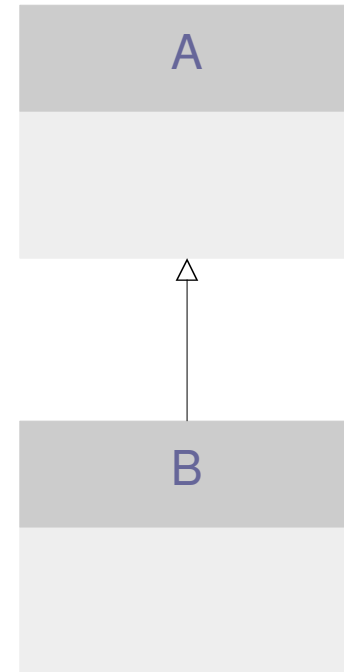
```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
}
```

```
class MyType {  
    public Integer i;  
    public Double d;  
    public Character c;  
    private String s;  
    private Random r;  
    private Picture p;  
  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
}
```

继承

- 新类包含已有类的方法和数据，并可修改 / 增添
- 语法：**extends**
 - A 称为父类 (super class) 或基类 (base class)
 - B 称为子类 (sub-class)

```
class A{  
    ...  
}  
  
public class B extends A {  
    ...  
}
```



继承

1. 子类有父类的所有方法和数据 .

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
}
```

```
public class MySubType extends MyType{  
  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        ms.set(1.0);  
        System.out.println(ms.get());  
        System.out.println(ms.i);  
    }  
}
```


继承

2. 子类可以定义新的方法和数据 .

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
}
```

```
public class MySubType extends MyType{  
    String s = new String("Hello");  
    public double add(double d){  
        return this.d + d;  
    }  
    public double add(String s){  
        return this.s + s;  
    }  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        System.out.println(ms.get());  
        System.out.println(ms.add(1.0));  
        System.out.println(ms.add("World"));  
    }  
}
```

继承

3. 子类可以更新父类的方法，称为**重写 (overriding)**

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
}
```

```
public class MySubType extends MyType{  
    public void set(double x){ i = (int)x; }  
    public double get() { return i; }  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        ms.set(1.0);  
        System.out.println(ms.get());  
        System.out.println(ms.i);  
        System.out.println(ms.d);  
    }  
}
```

继承

- 继承的基本功能
 - 子类有父类的所有方法和数据
 - 子类可以定义新的方法和数据
 - 子类可以重写 (**override**) 父类的方法

继承

- 当定义一个子类时发生了什么？
 - 可能性 1: **copy&paste** 父类的接口和数据，创建一个新的类

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
}
```



```
public class MySubType {  
    /*  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
    */  
  
    public string s;  
    public childMethods() {...}  
}
```



继承

- 当定义一个子类时发生了什么？
 - 可能性 2: 创建一个新的类，包含一个父类的对象作为数据成员 (组合!)

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d;}  
}
```



```
public class MySubType {  
    /*  
    public MyType m;  
    */  
  
    public string s;  
    public childMethods() {...}  
}
```



继承

- **super** 关键字

- 子类的对象包含一个隐藏的父类对象
- 在子类中，**super** 为该父类对象的引用
- 复习：**this** 关键字

```
public class MySubType extends MyType{
    /*
     MyType _this;
     MySubType _super;
    */

    public string s;
    public childMethods() {...}
}
```

- 作用

- 当方法被重写时，可以通过 **super** 调用父类的方法

继承

- 构造函数

- 在子类构造函数调用前，首先调用父类构造函数

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
    public MyType(){  
        System.out.println("In base class");  
    }  
}
```

```
public class MySubType extends MyType{  
    public MySubType (){  
        System.out.println("In sub class");  
    }  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
    }  
}
```

```
class MySubSubType extends MySubType{  
    public MySubSubType (){  
        System.out.println("In sub sub class");  
    }  
}
```

继承

- 构造函数
 - 调用父类带参数的构造函数
 - 必须出现在子类构造函数的首行

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
    public MyType(){  
        System.out.println("In base class");  
    }  
    public MyType(double d){  
        this.d = d;  
    }  
}
```

```
public class MySubType extends MyType{  
    public MySubType (){  
        super(1.0);  
        System.out.println("In sub class");  
    }  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
    }  
}
```


- 例子

```
public class Circle {
    public double radius;
    public String color;

    public Circle() {
        this.radius = 1.0;
        this.color = "red";
    }
    public Circle(double radius) {
        this.radius = radius;
        this.color = "red";
    }
    public Circle(double radius, String color) {
        this.radius = radius;
        this.color = color;
    }

    // Return the area of this Circle
    public double getArea() {
        return radius * radius * Math.PI;
    }

    public String toString() {
        return "This is a Circle";
    }
}
```

```
public class Cylinder extends Circle {
```

```
    public double height;
```

```
    public Cylinder() {
        super();
        this.height = 1.0;
    }
```

```
    public Cylinder(double height) {
        super();
        this.height = height;
    }
```

```
    public Cylinder(double height, double radius) {
        super(radius);
        this.height = height;
    }
```

```
    public Cylinder(double height,
                    double radius, String color) {
        super(radius, color);
        this.height = height;
    }
```

```
    // Return the volume of this Cylinder
    public double getVolume() {
        return super.getArea()*height; // Use Circle's getArea()
    }
```

```
    // overriding
    public double getArea() {
        return 2 * radius * Math.PI*height + 2*super.getArea();
    }
```

```
    public String toString() {
        return "This is a Cylinder";
    }
}
```

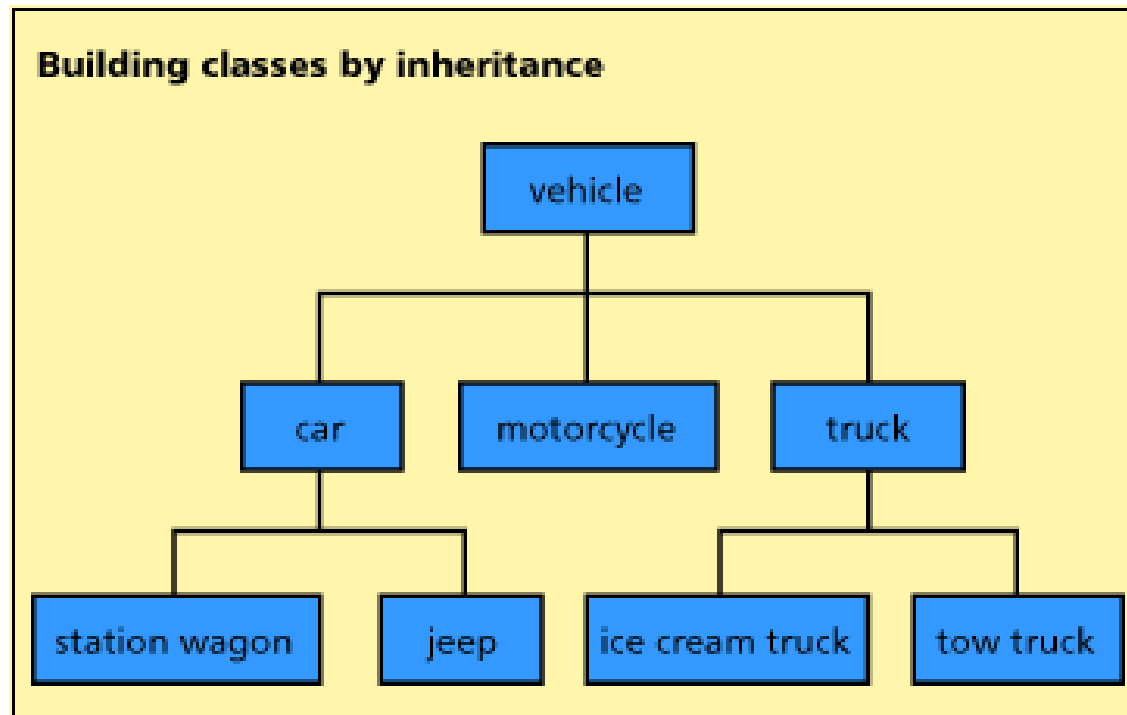
- 例子

```
public class Bicycle {  
  
    public int cadence;  
    public int gear;  
    public int speed;  
  
    // constructor  
    public Bicycle(int startCadence, int startSpeed, int startGear) {  
        gear = startGear;  
        cadence = startCadence;  
        speed = startSpeed;  
    }  
  
    public void setCadence(int newValue) {  
        cadence = newValue;  
    }  
  
    public void setGear(int newValue) {  
        gear = newValue;  
    }  
  
    public void applyBrake(int decrement) {  
        speed -= decrement;  
    }  
  
    public void speedUp(int increment) {  
        speed += increment;  
    }  
}
```

```
public class MountainBike extends Bicycle {  
  
    // the MountainBike subclass adds one field  
    public int seatHeight;  
  
    // the MountainBike subclass has one constructor  
    public MountainBike(int startHeight,  
                        int startCadence,  
                        int startSpeed,  
                        int startGear) {  
        super(startCadence, startSpeed, startGear);  
        seatHeight = startHeight;  
    }  
  
    // the MountainBike subclass adds one method  
    public void setHeight(int newValue) {  
        seatHeight = newValue;  
    }  
}
```

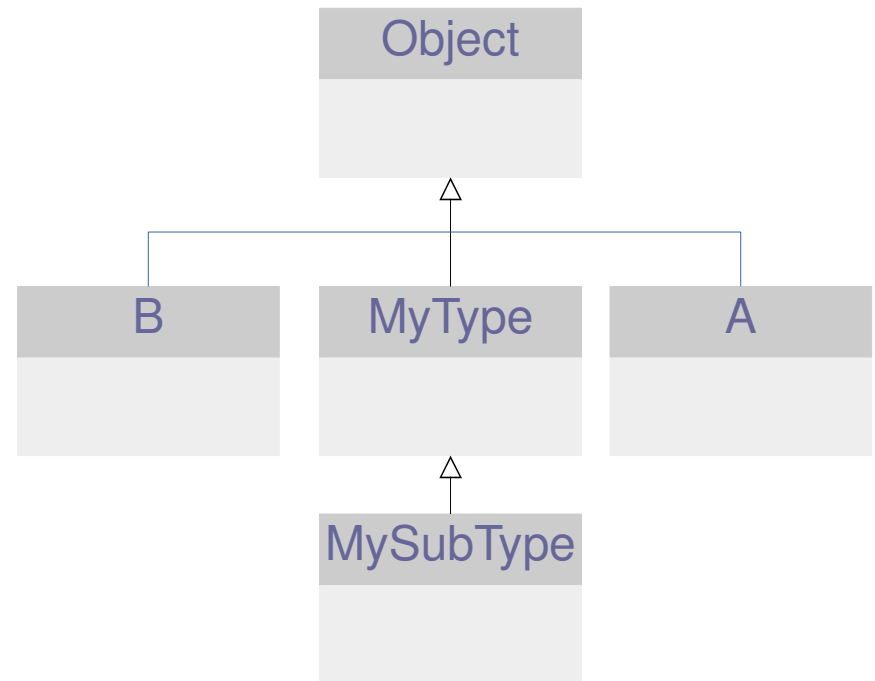
继承

- 不同类之间通过 父类 - 子类 关系构成一棵树



继承

- Object class
 - 每个类都是 Object class 的子类
 - Single root class hierarchy tree
 - toString(), equals(),...
 - Let's try



继承

- 重写 (override)
 - 子类重新实现父类的方法 (同一个函数)
- 重载 (overload)
 - 相同函数名，不同参数列表

继承

- 例子

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public void set(int y) {i = y;}  
    public double get() { return d; }  
}
```

```
public class MySubType extends MyType{  
    public void set(double x){ i = (int)x; }  
    public void set(char z) {c = z; }  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        ms.set(1.0);  
        System.out.println(ms.get());  
        System.out.println(ms.i);  
        System.out.println(ms.d);  
    }  
}
```

继承

- 例子

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    private void set(double x) { d = x;}  
    private void set(int y) {i = y;}  
    public double get() { return d; }  
}
```

```
public class MySubType extends MyType{  
    public void set(double x){ i = (int)x; }  
    public void set(char z) {c = z; }  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        ms.set(1.0);  
        System.out.println(ms.get());  
        System.out.println(ms.i);  
        System.out.println(ms.d);  
    }  
}
```

组合与继承

```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
}
```

```
public class MyCompType {  
    private MyType m = new MyType();  
    private String s;  
    public MyCompType(){  
        s = new String("Hello");  
    }  
}
```

```
public class MySubType extends MyType{  
  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        ms.set(1.0);  
        System.out.println(ms.get());  
        System.out.println(ms.i);  
    }  
}
```


组合与继承

- 同时使用组合与继承

```
public class MySubType extends MyType{
    String s = new String("Hello");
    public static void main(String [ ]args){
        MySubType ms = new MySubType();
        ms.set(1.0);
        System.out.println(ms.get());
        System.out.println(ms.i);
    }
}
```

组合与继承

- 比较
 - B, C 对象都包含一个 A 的对象
 - 访问方式不同
 - b.a.get(); b.a.set(1);
 - c.get(); c.set(1);
 - 设计角度：类间关系不同
 - has-a 关系
 - is-a 关系

```
class A{
    ...
    public get(){}
    public set(int i){}
}

class B{
    public A a = new A();
}

class C extends A {
    ...
}
```

组合与继承

- 没有 **is-a** 关系，但需能调用另一类的所有方法

```
class SpaceShipControls{
  void up(int v) {}
  void down(int v) {}
  void left(int v) {}
  void right(int v) {}
  void forward(int v) {}
  void backward(int v) {}
}
```

```
class SpaceShip extends SpaceShipControls{
  ...
  Static public void main(String []args){
    SpaceShip s = new SpaceShip();
    s.up(); s.forward();
  }
}
```

代理 (Delegation)
介于组合与继承之间

```
class SpaceShip {
  Private SpaceShipControls s;
  public void up() {s.up();}
  public void down() {s.down();}
  public void left() {s.left();}
  public void up() {s.right();}
  public void forward() {s.forward();}
  public void backward() {s.backward();}
}
```

总结

- 组合
 - 类 **B** 包含类 **A** 作为数据成员
 - has-a
- 继承
 - 类 **B** 具有类 **A** 的所有数据与方法，并能增添修改
 - is-a
 - 方法重写 (override)