

OOP with Java

Yuanbin Wu
cs@ecnu

OOP with Java

- 通知
 - Project 4: 5 月 5 日晚 9 点

- 复习
 - 类的复用
 - 组合 (composition):
 - has-a 关系

```
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");  
    }  
}
```

- 复习
 - 继承 (inheritance)
 - is-a 关系

```
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 void set(double x){ i = (int)x; }  
    public double get() { return i; }  
  
    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"));  
    }  
}
```

- 复习
 - 继承
 - 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
 - super 关键字
 - 每一个子类对象都隐含包含一个父类对象
 - Object 对象
 - Single root class hierarchy tree
 - 方法 :

```
boolean equals(Object o)
```

```
String toString()
```

```
class MyType {  
  
    public int i;  
    public double d;  
    public char c;  
    public void set(double x) { d = x;}  
    public double get() { return d; }  
  
    public static void main(String [ ]args){  
        MyType m = new MyType();  
        MyType n = new MyType();  
        String s = "hello";  
        m.equals(n);  
        m.equals(s);  
    }  
}
```

OOP with Java

- protected
- upcasting
- final 关键字

protected

- 访问控制
 - package access
 - public
 - private

protected

- 函数重写

```
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 double foo(){ return get(); }  
    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);  
    }  
}
```


protected

- 函数重写？

```
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;}  
    private double get() { return d; }  
}
```

```
public class MySubType extends MyType{  
  
    // can not access!!  
    // public double foo(){ return get(); }  
    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);  
    }  
}
```

Protected

- 父类的方法
 - public
 - private
 - 是否有可能被子类访问而不被外界访问？

protected

- **protected**
 - 可以被子类 / 同一包中的类访问，不能被其他类访问
 - 弱化的 `private`
 - 同时赋予 `package access`

protected

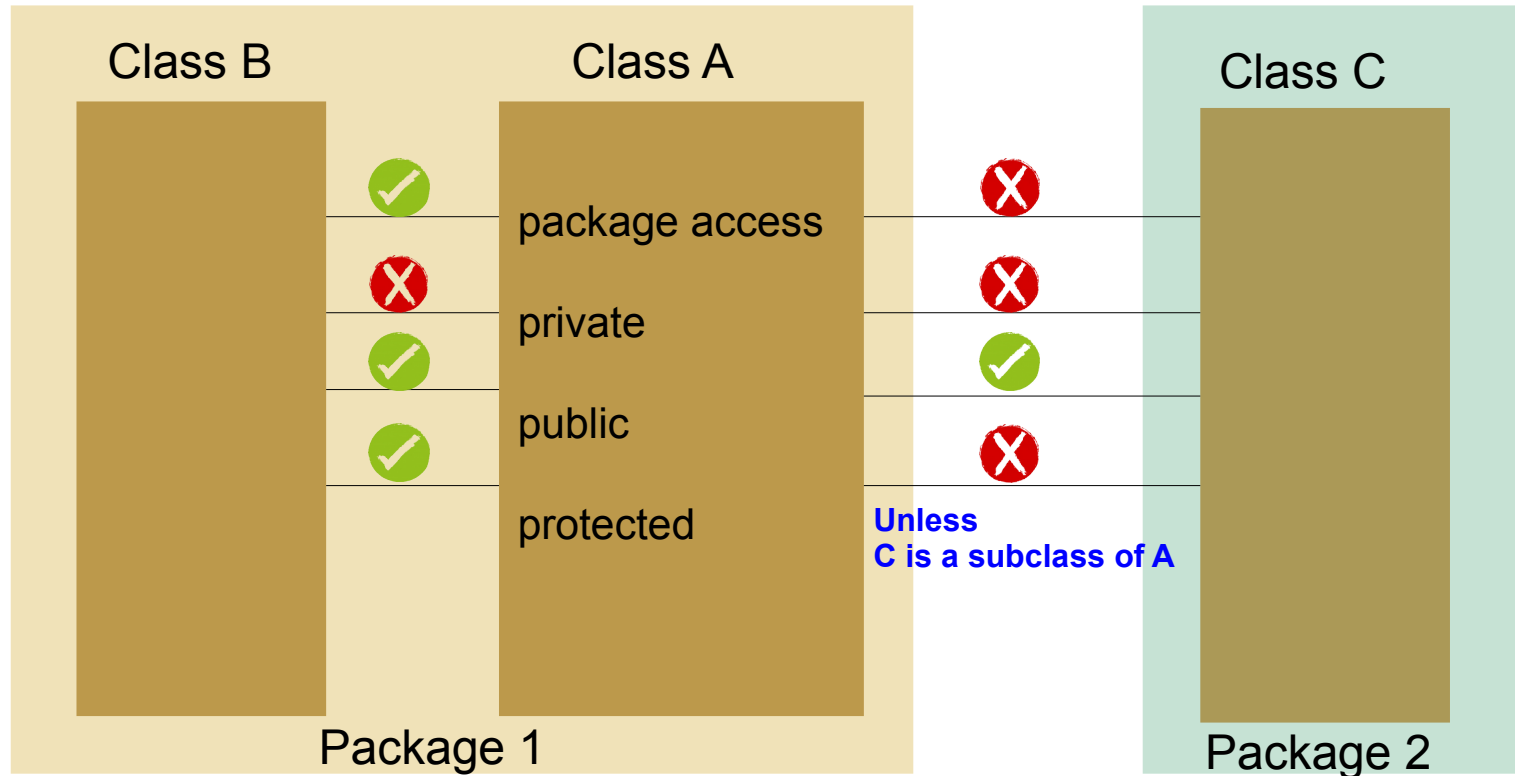
```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    protected void set(double x) { d = x;}  
    protected void set(int y) {i = y;}  
    protected double get() { return d; }  
}
```

```
public class MySubType extends MyType{  
  
    public double foo(){ return get(); }  
    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);  
    }  
}
```

Protected

- 访问控制
 - package access
 - public
 - private
 - protected

Protected



Protected

Modifier	Class	Package	Subclass	World
public	Y	Y	Y	Y
protected	Y	Y	Y	N
no modifier	Y	Y	N	N
private	Y	N	N	N

final 关键字

- final 关键字
 - 不同的环境下有不同含义
 - 基本意义为：**不能被改变**

final 关键字

- final 数据
 - 编译时常数
 - 一旦被赋值就不能被修改

final 关键字

- final 数据
 - 例子

```
class MyType {
    public int i;
    public final double d = 1;
    public char c;
    public double get() { return d; }
    public void set(double x) {d = x;}

    public static void main(String []args){
        MyType m = new MyType();
        // m.d = 2.0;
    }
}
```

final 关键字

- final 数据
 - final 引用

```
class MyType {
    public int i;
    public final double d = 1;
    public char c;
    public final int [ ] a = new int[10];

    public double get() { return d; }
    public void set(double x) {d = x;}
    public static void main(String []args){
        MyType m = new MyType();
        m.a[0] = 1.0;
        //m.a = new int[10];
    }
}
```

final 关键字

- final 数据
 - final + static
 - static final int i = 1;
 - 仅有一个不可变的存储空间

final 关键字

- final 数据
 - Blank final

final 成员在定义时可以不给初值
必须在构造函数中初始化

```
class MyType {  
    public int i;  
    public final double d;  
    public char c;  
    public double get() { return d; }  
    public MyType(double x){ d = x; }  
  
    public static void main(String []args){  
        MyType m = new MyType(1.0);  
        System.out.println(m.get());  
        // m.d = 2.0;  
    }  
}
```

final 关键字

- final 参数

- 函数不能修改参数的引用。

```
class FinalArgs {  
    public static void set(final int [ ] a) {  
        a[0] = 1;  
        // a = new int [10];  
    }  
    public static void main(String []args){  
        int [ ]a = new int[10];  
        FinalArgs.set(a);  
    }  
}
```

final 关键字

- final method
 - 不能被重写

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

```
public class MySubType extends MyType{  
    // can't override  
    /* public void set(double d){  
        System.out.println("Sub-class set");  
        i = int(d);  
    } */  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        MyType m = ms;  
        m.set(1.0);  
    }  
}
```

final 关键字

- final class
 - 不能被继承

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

```
// can not be extended  
/*  
public class MySubType extends MyType{  
    public void set(double d){  
        System.out.println("Sub-class set");  
        i = int(d);  
    }  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        MyType m = ms;  
        m.set(1.0);  
    }  
}*/
```


不可变类型

- 不可变类型 (immutable)
 - 类型的对象一旦创建就不能被改变
 - 例子 **String** 类, **Integer** 类, **Float** 类 ...

```
String s = "Hello World";  
System.out.println(s.toUpperCase());  
System.out.println(s);
```

- 可变类型 (mutable)
 - 例子 **MyType**, 数组

```
MyType m = new MyType();  
System.out.println(s.get());  
m.set(1.0);  
System.out.println(s.get());
```

```
int []a = {1, 2, 3};  
System.out.println(a[0]);  
a[0] = 1  
System.out.println(a[0]);
```

final 关键字

- 不可变 (immutable)
 - 优点：易于使用，易于 debug, 易于维护
 - 缺点：空间 / 时间消耗

final 关键字

- final 关键字
 - 帮助构造不可变对象
 - Let's try it.

```
class MyType {
    final public int i;
    final public double d;
    final public char c;

    public MyType set(double x) {
        return new MyType(i, x, c);
    }
    public double get() { return d; }

    public MyType(int x, double y, char z){
        i = x;
        d = y;
        c = z;
    }

    public static void main(String []argv){
        MyType m = new MyType(1, 2, '\0');
        MyType n = m.set(3);
        System.out.println(n.d);
        System.out.println(m.d);
    }
}
```

- 复习

- Protected

- 可以被子类 / 同一包中的类访问，不能被其他类访问
 - 弱化的 `private`
 - 同时赋予 `package access`

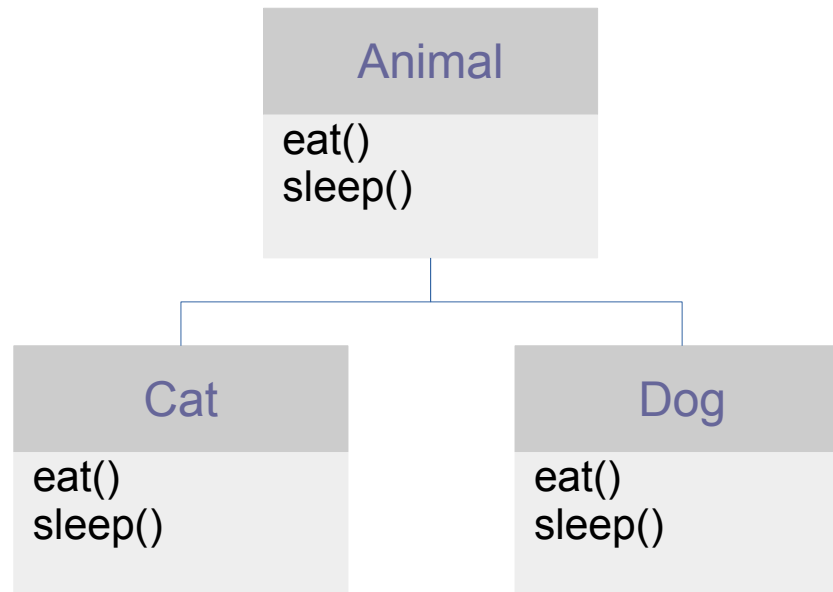
```
class MyType {  
    public int i;  
    public double d;  
    public char c;  
    protected void set(double x) { d = x;}  
    protected void set(int y) {i = y;}  
    public double get() { return d; }  
}
```

```
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);  
    }  
}
```

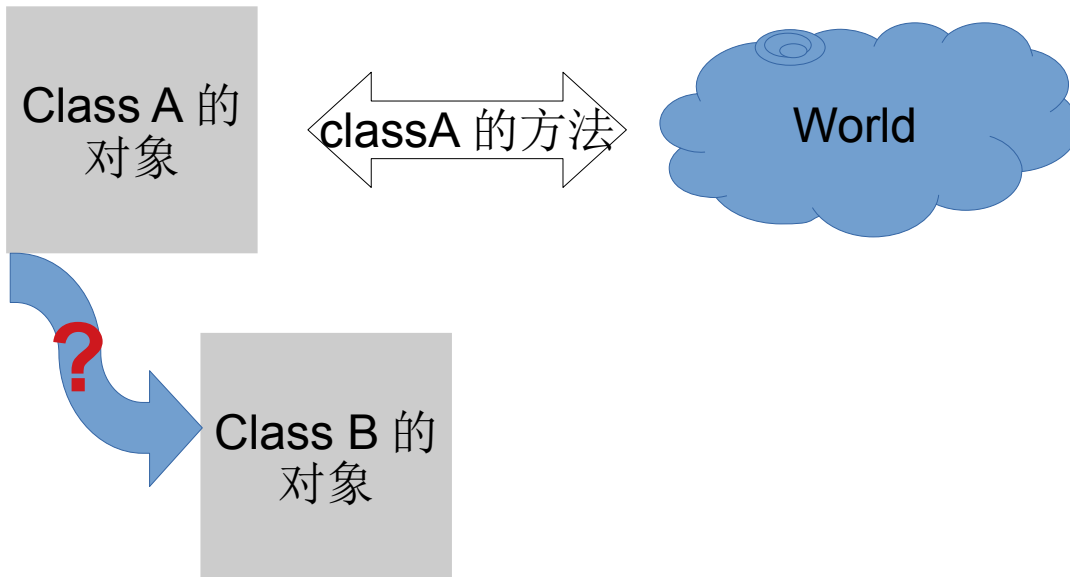
- 复习
 - final 关键字
 - final 数据
 - `static final int j = 1;`
 - `final int[] a = new int [10];`
 - Blank final, 构造函数中初始化
 - final 参数
 - final 方法：不能重写
 - final 类：不能继承
 - immutable

Upcasting

- 继承
 - 子类拥有父类所有的数据和方法



Upcasting

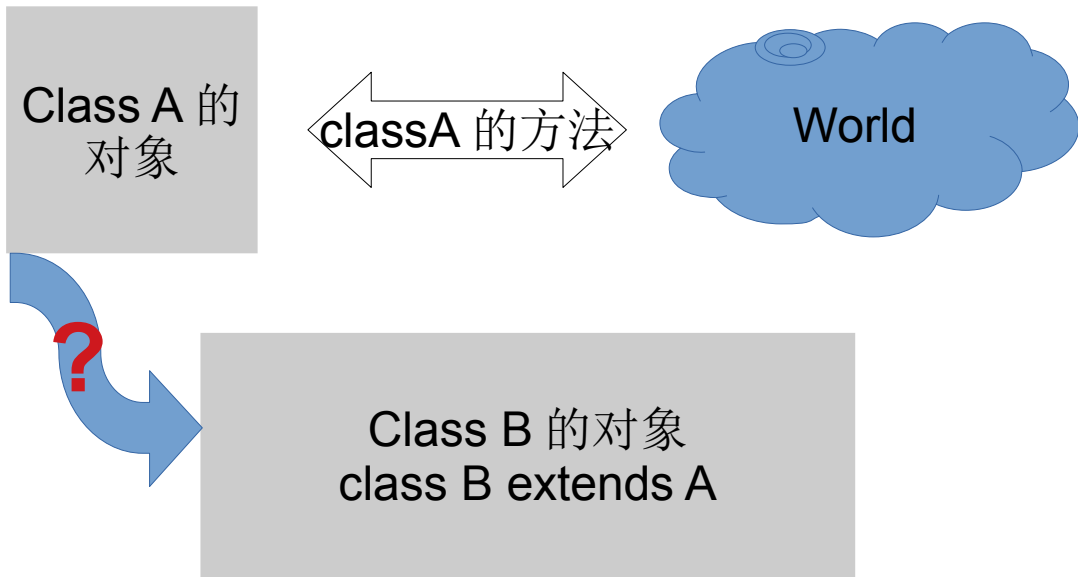


Cannot

A 与 B 有不同的类型

```
class B {  
    // ...  
}  
  
class A {  
    // ...  
    public void foo() {}  
}  
  
class C {  
    public void bar(A a) { a.foo(); }  
  
    public static void main(String []argv)  
    {  
        A a = new A();  
        B b = new B();  
        C c = new C();  
        a.foo();  
        c.bar(a);  
        // replace a with b  
        b.foo();  
        c.bar(b);  
        A a1 = b;  
    }  
}
```

Upcasting



Yes

子类拥有父类所有的数据和方法

```
class B extends A {  
    // ...  
}  
  
class A {  
    // ...  
    public void foo() {}  
}  
  
class C {  
    public void bar(A a) { a.foo(); }  
  
    public static void main(String []argv)  
    {  
        A a = new A();  
        B b = new B();  
        C c = new C();  
        a.foo();  
        c.bar(a);  
        // replace a with b  
        b.foo();  
        c.bar(b);  
        A a1 = b;  
    }  
}
```


Upcasting

- 类型关系：
 - 子类是**一种**父类 (“is-a 关系”)
 - the sub-class **is a type of** the base class

Upcasting

- 例子

```
class Instrument {
    public void play() {}
    static void tune(Instrument i) {
        // ...
        i.play();
        // ...
    }
}

public class Wind extends Instrument {
    public static void main(String[] args) {

        Wind flute = new Wind();

        Instrument.tune(flute);
    }
}
```

Upcasting

Upcasting

- 例子

```
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();
        MyType m = ms;

        System.out.println(m.get());
        System.out.println(ms.add("World"));

        m.set(1.0);
        System.out.println(m.get());
        System.out.println(ms.get());
    }
}
```

Upcasting

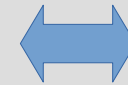
- Upcasting (向上转换)
 - 需要父类对象的地方可以用子类对象带入
 - 引用，函数参数
 - 一种类型转换
 - 安全的
 - 子类拥有父类所有的数据和方法
 - 其他的类型转换？
 - 类型间关系

Upcasting

- 例子

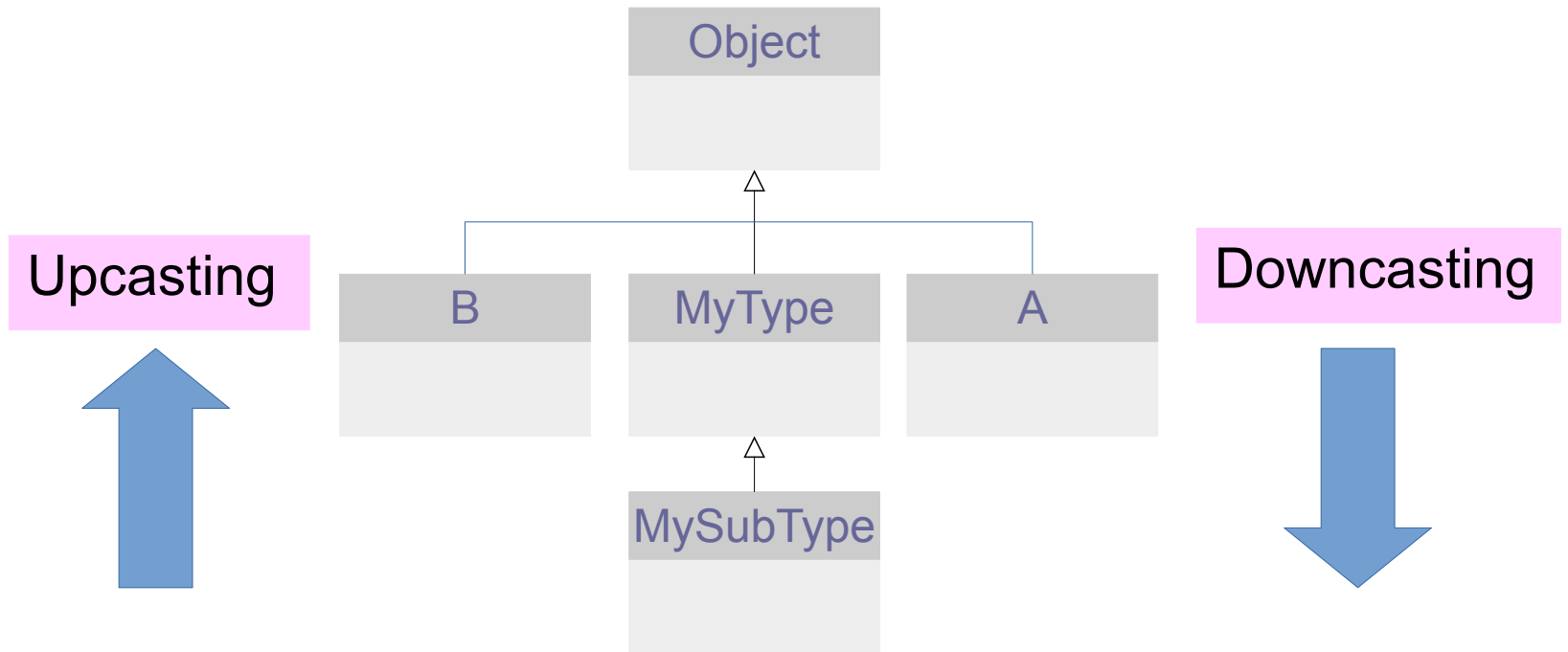
```
public class MySubType extends MyType{  
  
    String s = new String("Hello");  
    public double add(double d){return this.d + d;}  
    public double add(String s){return this.s + s;}  
  
    public static void main(String [ ]args){  
        MySubType ms = new MySubType();  
        MyType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

```
int i = 5;  
double d = i;
```



Upcasting

- Upcasting



Upcasting

- 子类重写了父类方法？

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

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

多态

Upcasting

- 类型转化
 - 基本类型
 - `int` → `double` (安全, 自动转换)
 - `double` → `int` (损失精度, 强制转换)
 - 基本类型与 wrapper
 - `int` → `Integer` (autoboxing)
 - `Integer` → `int` (unboxing)
 - 类
 - 不支持强制转化
 - 子类 → 父类 (安全, upcasting)
 - 父类 → 子类 (downcasting)

Upcasting

- Downcasting

- `MySubType ms = (MySubType)m;`
- 仅在 `m` 确实指向子类对象时才能进行
- 运行时类型信息 (RTTI)

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

        MyType m = ms;
        m.set(1.0);

        MySubType n = (MySubType)m;
        m.set(1.0);
    }
}
```

Upcasting

- 总结
 - 子类是一种父类 (is-a)
 - 父类的引用可以指向子类对象

<http://new-play.tudou.com/v/571411926.html?>