

CSC 347 - Concepts of Programming Languages

Scala Classes

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Learning Objectives

? Complex data in object-oriented programming?

- Identify classes and objects in Scala
- Use class parameters to initialize, query, and modify object values
- Use Scala objects to implement singletons
- Describe methods



Classes

- Define a class `C`

```
1 class C (f1:Int, val f2:Int, var f3:Int):  
2    //...
```

- Has one constructor with parameters `f1`, `f2`, `f3`
- Instantiate the class `C`

```
1 val c = new C (2, 3, 5)
```

- Instance of `C` is heap allocated
- `c` is a reference to instance



Class Parameters

```
1 class C (f1:Int, val f2:Int, var f3:Int):  
2   //...
```

- **f1** private and immutable
- **f2** public immutable
- **f3** public mutable

- Execute in REPL

- Output

```
1 scala> val c = new C (2, 3, 5)  
2 c: C = C@8bd1b6a  
3  
4 scala> c.f1  
5 <console>:10: error: value f1 is not a member of C  
6  
7 scala> c.f2  
8 res1: Int = 3  
9  
10 scala> c.f3  
11 res2: Int = 5  
12  
13 scala> c.f2 = 10  
14 <console>:9: error: reassignment to val  
15  
16 scala> c.f3 = 10  
17 c.f3: Int = 10
```



Class Parameter Details

- Class parameters simultaneously declare constructors and accessor methods
- Components of the class body are `public` by default

Scala

```
1 class C1 (x:Int):  
2   def double() = x+x  
3 end C1
```

Expressed in Java

```
1 public class C1 {  
2   private final int x;  
3  
4   public C1(int x) { this.x = x; }  
5  
6   public int double() { return x+x; }  
7 }
```



Class Parameter Details

- Immutable class parameters can be initialized but not modified

Scala

```
1 class C2 (val x:Int):  
2   def double() = x+x  
3 end C2
```

Expressed in Java

```
1 public class C2 {  
2   private final int x;  
3  
4   public C2(int x) { this.x = x; }  
5  
6   public int x() { return x; }  
7  
8   public int double() { return x+x; }  
9 }
```



Class Parameter Details

- Mutable class parameters can be changed even after initialization

Scala

```
1 class C3 (var x:Int):  
2   def double() = x+x  
3 end C3
```

Expressed in Java

```
1 public class C3 {  
2   private int x;  
3  
4   public C3(int x) { this.x = x; }  
5  
6   public int x() { return x; }  
7  
8   public void setX(int x) { this.x = x; }  
9  
10  public int double() { return x+x; }  
11 }
```



Class Body

- Class body contains
 - Field declarations
(`val` or `var`)
 - Constructor code
 - Method definitions

```
1 class C (f1:Int, val f2:Int, var f3:Int):  
2   val f4 = f1 * f2  
3   var f5 = f2 * f3  
4  
5   println ("Constructing instance of C")  
6  
7   def m (x:Int) : Int =  
8     // cannot reassign to f1, f2, f4  
9     f3 = f3 + 1  
10    f5 = f5 + 1  
11    f1 * f3 * x  
12  end m  
13 end C
```



Methods vs. Fields

- `val` field: `val x = 1` ; strict, initialized once
- `def` non-parameterized method: `def y = 2` ; non-strict, executed every time
- `lazy val` : memoized `def` , initialized on demand

Scala

```
1 class C:  
2   val x = 1  
3   def y = 2  
4   lazy val z = x + y  
5 end C
```

Expressed in Java

```
1 public class C {  
2   private final int x = 1;  
3   public int x() { return x; }  
4  
5   public int y() { return 2; }  
6  
7   private Integer z = null;  
8   public int z() {  
9     if (z == null) z = x + y();  
10    return z;  
11  }  
12 }
```



Objects

- `object` declares a single instance, accessible through the object name
- Language support for the [singleton design pattern](#)

```
1 object C:  
2   var count:Int = 0  
3 end C  
4  
5 C.count = C.count + 1
```



Objects

- Singleton objects `object` are instantiated on program startup
- Method `main` must be declared in an `object`

Java

```
1 public class C {  
2     public static void main (String[] args) {  
3         //...  
4     }  
5 }
```

Scala

```
1 object C:  
2     def main (args:Array[String]) : Unit =  
3         //...  
4     end main  
5 end C
```



Companion Objects

- Many languages distinguish data and methods belonging to *an instance* vs. *a class*

Java: static vs. non-static

- `static` components belong to a class
- All other belong to instance of class

```
1 class C {
2     private int f1 = 0;
3     public int m1 () {
4         C.f2 = 3;
5         return f1;
6     }
7     private static int f2 = 0;
8     public static int m2 (C other) {
9         other.f1 = 5;
10        return f2;
11    }
12 }
```

Scala: Companion object replaces `static`

- All data and methods belong to objects
- Companion related to other instances

```
1 class C:
2     private var f1:Int = 0
3     def m1 () : Int =
4         C.f2 = 3
5         f1
6
7 object C:
8     private var f2:Int = 0
9     def m2 (other: C) : Int =
10         other.f1 = 5
11         f2
```



Summary

- Scala class parameters and factory methods replace constructors
- Scala has builtin support for the Singleton design pattern
- Scala has `object` and *companion objects* instead of `static`