Northeastern University

Lecture 7: Object Oriented Programming - 2

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Materials are edited by Prof. Jones Yu from

Liang, Y. Daniel. Introduction to Java Programming and Data Structures, Comprehensive Version, 12th edition, Pearson, 2019.

Outline

- Objects and Classes
- Thinking in Objects

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Objects and Classes

Static Variables, Constants, and Methods

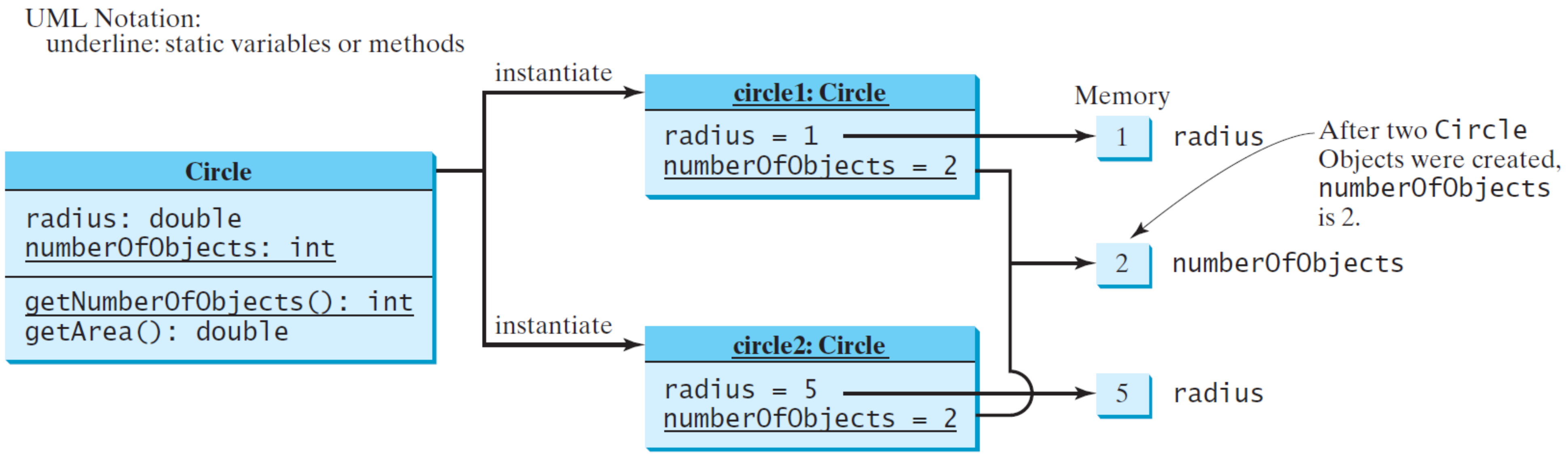
Instance Variables and Methods

- Instance variables belong to a specific instance (object).
- Instance methods are called by an instance of the class (object).

Static Variables, Constants and Methods

- Static variables are shared by all the instances of the class (objects).
- Static constants are final variables shared by all the instances of the class (objects).
- Static methods are not tied to a specific object. To call such method, using `ClassName.MethodName()`.
    - A static method cannot access instance members (instance data fields and methods).
- To declare static variables, constants, and methods, use the static modifier.

Static Variables, Constants and Methods



Exercise

- What is static variable?
- What's the difference between static variables and instance variables?

Answer

- Static variables:
  - » The variables that can be shared by all objects of a class.
  - » Static variables are also called *class variables.*
- Instance variables:
  - » The variables that belong to an object.
- Both static variables and instance variables are sometimes called *fields*, *data fields* or *data members.*
- Differences:
  - » Each object has one copy of its instance variables. They are not shared with other objects of the same class type.

Answer

Data Fields
(Member Variables)

Instance Variable

```
class City
{
   int count;
   ...
}
```

Class Variable

```
class City
{
   static int count;
   ...
}
```

Visibility Modifiers

Visibility Modifiers and Accessor/Mutator Methods

- By default, the class, variable, or method can be accessed by any class in the same package.
  - Public:
    - The class, data, or method is visible to any class in any package.
  - Private:
    - The data or methods can be accessed only by the declaring class.
    - The get (accessor) and set (mutator) methods are used to read and modify private properties.

The private modifier restricts access to within a class, the default modifier restricts access to within a package, and the public modifier enables unrestricted access.

```
package p1;

public class C1 {
  public int x;
  int y;
  private int z;

  public void m1() {
  }
  void m2() {
  }
  private void m3() {
  }
}
```

```
package p1;

public class C2 {
  void aMethod() {
    C1 o = new C1();
    can access o.x;
    can access o.y;
    cannot access o.z;

    can invoke o.m1();
    can invoke o.m2();
    cannot invoke o.m3();
  }
}
```

```
package p2;

public class C3 {
  void aMethod() {
    C1 o = new C1();
    can access o.x;
    cannot access o.y;
    cannot access o.z;

    can invoke o.m1();
    cannot invoke o.m2();
    cannot invoke o.m3();
  }
}
```

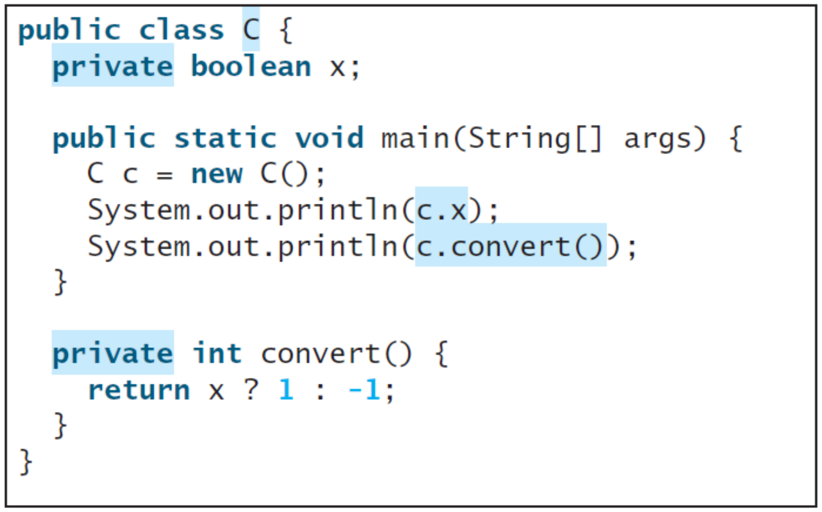
```
package p1;

class C1 {
  ...
}
```

```
package p1;

public class C2 {
  can access C1
}
```

```
package p2;

public class C3 {
  cannot access C1;
  can access C2;
}
```

Note

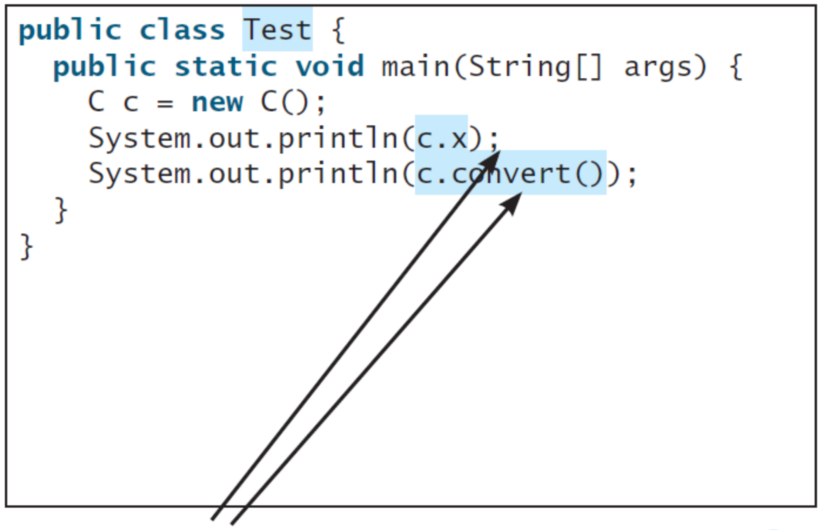
- An object cannot access its private members, as shown in (b). It is OK, however, if the object is declared in its own class. (a)



```
public class C {
  private boolean x;

  public static void main(String[] args) {
    C c = new C();
    System.out.println(c.x);
    System.out.println(c.convert());
  }

  private int convert() {
    return x ? 1 : -1;
  }
}
```

(a) This is okay because object c is used inside the class C.

OK



```
public class Test {
  public static void main(String[] args) {
    C c = new C();
    System.out.println(c.x);
    System.out.println(c.convert());
  }
}
```

(b) This is wrong because x and convert are private in class C.

Error

Exercise

- Type the following code into a Java project.
- Run the code, find the issue and fix the problem.

```java
public class Test {
    int x;

    public Test(String t) {
        System.out.println("Test");
    }

    public static void main(String[] args) {
        Test test = new Test();
        System.out.println(test.x);
    }
}
```

Test.java

Answer

- The program has a compile error because Test does not have a default constructor.