Monsoon 2019

Nested Classes

Object Oriented Programming

by

Dr. Rajendra Prasath

Indian Institute of Information Technology

Sri City – 517 646, Andhra Pradesh, India

Recap: Objects in JAVA ?

- An entity that has **state** and **behaviour** is known as an object
  - **Examples:** Chair, bike, marker, pen, table, car etc
  - It can be physical or logical
- An object has three characteristics:
  - **State:** represents data (value) of an object
  - **Behaviour:** represents the behaviour (functionality) of an object such as deposit, withdraw and so on
  - **Identity (Internally used):**
    - Signature (unique) of the object
    - Object identity is typically implemented via a unique ID
    - The value of the ID is not visible to the external user
    - But, Internally by JVM to identify each object uniquely

Recap: this keyword in java

- **Why use this keyword in JAVA?**
  - Main purpose: To differentiate the formal parameter and data members of class
  - Why?
    - whenever the formal parameter and data members of the class are similar then jvm gets ambiguity (no clarity between formal parameter and member of the class)
    - So to differentiate between formal parameter and data member of the class, the data member of the class must be preceded by "this".
  - "**this**" keyword can be use in two ways.
    - **this . (this dot)**
    - **this() (this off)**

this – invoke a Method: Recap

- **Example:**

```
Class P {
        Person obj;
        P (Person obj) {
                this.obj = obj;
        }
        void display() {
                System.out.println("Name: "
                        + obj.name);
        }
}
```

```
Class Person {
        String name = "Alfred De Souza";
        Person() {
                P p = new P(this);
                p.display();
        }
        public static void main(String
args[]) {
                Person p = new Person();
        }
}
```

Output: **Alfred De Souza**

Recap: static – Create a counter

```
public class Counter {
    static int count = 0;

    public Counter() {
        count++;
        System.out.println("Counter: " + count);
    }

    public static void main(String[] args) {
        Counter c;
        c = new Counter();
        c = new Counter();
        c = new Counter();
        c = new Counter();
    }
}
```

Nested Classes

- **What is a nested class?**
- A class within another class is known as **Nested class**
- The scope of the nested is bounded by the scope of its enclosing class.
- The class that holds the inner class is called the outer class.
- Nested Classes are Divided into two Types:
  - **Non-Static Nested Classes** – These are the non-static members of a class.
  - **Static Nested Classes** – These are the static members of a class.

Nested Classes - Advantages

- **3 advantages of inner classes in java**

  - Nested classes **represent a special type of relationship** that is it can access all the members (data members and methods) of outer class including private.

  - Nested classes are used to develop **more readable and maintainable code** because it logically group classes and interfaces in one place only.

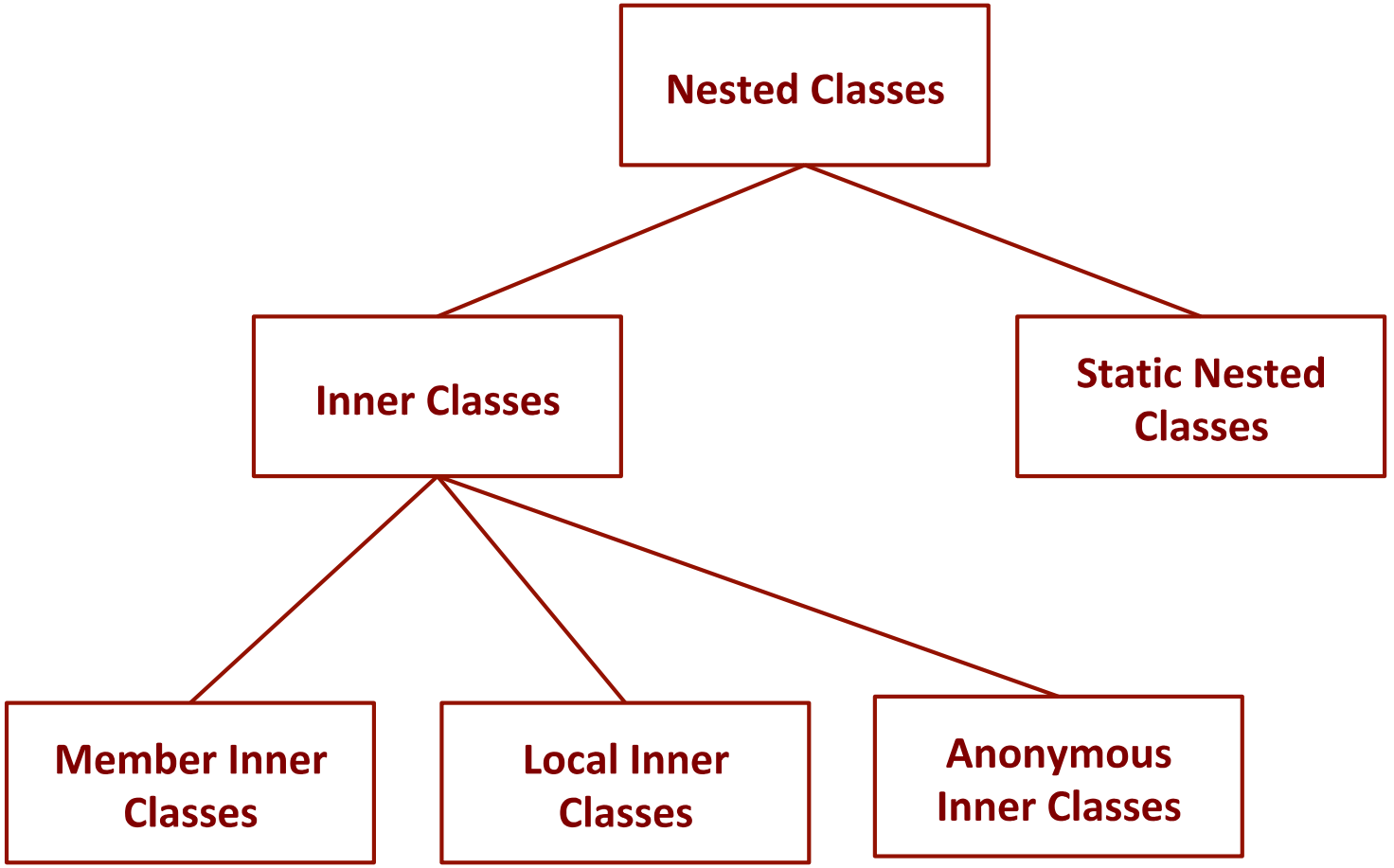
  - **Code Optimization:** It requires less code to write.

Nested Classes - Advantages

- **Member Inner Class:** A class created within class and outside method
- **Anonymous Inner Class:** A class created for implementing interface or extending class
  - Its name is decided by the java compiler
- **Local Inner Class:** A class created within method
- **Static Nested Class:** A static class created within class

Nested Classes - Hierachy

- Various Types of Nested Classes:



Static Nested Classes in JAVA

- **What is a static nested class?**
- A static nested class is the one that has static modifier applied.
- Since it is static, it can not be applied to non-static members of its enclosing class directly.
- **Syntax:**

```
class Outer {
        class Inner {
        }
}
```

- **this** – refers to the currently executing inner class
- To get this for outer class, use "**Outer.this**"

Java Static Nested Class

- A static class created inside a class is called static nested class in java
- It cannot access non- static data members and methods
- It can be accessed by outer class name
- It can access static data members of outer class including private
- Static nested class cannot access non-static (instance) data member or method

- **Syntax:**

```
Outer.Inner obectName = new Outer.Inner();
```

Static Nested Class - Example

```
class Outer {
        static int id=11;
        static String name="";
        static class Inner {
                void display() {
                        System.out.println("ID is: "+id);
                        System.out.println("Name is: "+name);
                }
        }
        public static void main(String args[] {
                Outer.Inner obj=new Outer.Inner();
                obj.dispaly();
        }
}
```

Static Nested Class - Variation

```
class Outer {
        static int id=11;
        static String name="";
        static class Inner {
                static void display() {
                        System.out.println("ID is: "+id);
                        System.out.println("Name is: "+name);
                }
        }
        public static void main(String args[] {
                Outer.Inner.dispaly();
        }
}
```

One More Static Nested Class

```
class Outer {
        private static int age=24;
        static class Inner {
                int getAge() {
                        return age;
                }
        }
        public static void main(String args[] {
                Outer.Inner inn = new Outer.Inner();
                System.out.println("Age = " + inn.getAge() );
        }
}
```

One More Static Nested Class

```
class Outer {
        private static int age=28;
        static class Inner {
                int age = 21;
                int getAge() {
                        return age;
                }
        }
        public static void main(String args[] {
                Outer.Inner n1 = new Outer.Inner();
                System.out.println("Age = " + n1.getAge() );
        }
}
```

Member with the same name !!

Inner member will shadow the outer class member

Static Nested Class

- Can **access only static members** of outer class inside a static nested class and **Can not access the non-static members** of outer class inside a static nested class

```
class Outer {
        static int i;         //static field of Outer
        int j;          //Non-static field of Outer
        void methodOne() { // Non-static method of Outer
        }
        static void methodTwo() { // static method of Outer
        }
        static class Nested {
                void methodOfInner() {
                        System.out.println(i); // static field can be accessed
                        System.out.println(j); // Compile time error - Non-static field

                        methodTwo(); // can access static method
                        methodOne(); // Compile time error: non-static field
                }
        }
}
```

Static Nested Class - Access

- Non-static Members Of Outer Class Cannot Access Inside a Static Nested Class

```
class Outer {
    int age = 21; //Non-static field of Outer Class
    static class Inner{
        int yrs = age;
        int getAge() {
            return yrs;
        }
    }

    public static void main(String[] args) {
        Outer.Inner m1 = new Outer.Inner();
        System.out.println("Sr. Number :" + m1.getAge());
    }
}
```

Compiler Error !!

This error is due to the assignment of non-static data field of outer class to non-static data field.

Static Nested Class - Access

- Non-static Members Of Outer Class Cannot Access Inside a Static Nested Class

```
class Outer {
    static int age = 21; //Non-static field of Outer Class
    static class Inner{
        int yrs = age;
        int getAge() {
            return yrs;
        }
    }

    public static void main(String[] args) {
        Outer.Inner m1 = new Outer.Inner();
        System.out.println("Sr. Number :" + m1.getAge());
    }
}
```

No Compiler Error

Because assignment of static data field of outer class to non-static data field.

More than one static nested class

```
class Outer {
    int i = 10;                 // Non-static Field of Outer
    static void methodOne() {
        System.out.println("Static method of OuterClass");
    }
    static class NestedClassOne {
        int i = 20;             // Non-static Field of NestedClassOne
        static void methodOne() {
            System.out.println("Static method of NestedClassOne");
        }
    }
    static class NestedClassTwo {
        int i = 30;             // Non-static Field of NestedClassTwo
        static void methodOne() {
        System.out.println("static method of NestedClassTwo");
        }
    }
```

More than one … (contd.)

Main() Method

```
    public static void main(String[] args) {
        // static member can be accessed directly through class name
        Outer.methodOne();

        Outer outer = new Outer();
        //Instance member must be accessed through object ref
        System.out.println(outer.i);

        Outer.NestedClassOne.methodOne();
        Outer.NestedClassOne nestedOne = new Outer.NestedClassOne();
        System.out.println(nestedOne.i);

        Outer.NestedClassTwo.methodOne();
        Outer.NestedClassTwo nestedTwo = new Outer.NestedClassTwo();
        System.out.println(nestedTwo.i);
    }
}
```

Overloading – Methods / Constructors

```
class Outer {
        static class Nested {
                Nested () {
                        //First constructor
                }
                Nested (int i) {
                        //Second Constructor with one Parameter
                }
                Nested (int i, int j) {
                        //Third Constructor with two Parameters
                }
                void methodOne () {
                        //Overloaded method (without Parameter)
                }
                void methodOne (int i) {
                        //Overloaded method (with one Parameter)
                }
                void methodOne (int i, int j) {
                        //Overloaded method (Two Paramters)
                }
        }
}
```

Inner Classes in JAVA

- A non-static class that is created inside a class but outside a method is called member inner class
- A Member Inner Class is a class whose definition is directly enclosed by another class or interface declaration
- Instance of a **Member Inner Class** can only be created if we have a reference to an instance of outer class
- Purpose:
  - Provide More Security - make inner class Properties specific to ONLY outer classes
  - Make more than one property of classes pivate

Member Inner Class (Within class)

```
class Outer {
        private static int age=28;
        class Inner {
                int getAge() {
                        return age;
                }
        }
        void displayAge() {
                Inner in = new Inner();
                System.out.println("Age = " + in.getAge() );
        }
        public static void main(String args[] {
                Outer out = new Outer();
                out.displayAge();
        }
}
```

Member Inner Class (outside class)

```
class Outer {
        private static int age = 28;
        class Inner {
                int getAge() {
                        return age;
                }
        }
        public static void main(String args[] {
                Outer out = new Outer();
                Outer.Inner oin = out.new Inner();
                System.out.println("Age = " + oin.getAge() );
        }
}
```

Member Inner Class – Key Points

- **Member inner class must contain only non-static members**
- **Static Members are not allowed inside inner classes**

```
class Outer {
    //Member Inner Class : Class As a Non-Static Member
    class Inner {
        int i;                      // can contain non-static field
        static int j = 10;          // It gives compile time error

        // Should not contain static field
        void methodOne() {
        // can have non-static method
        }
        static void methodTwo(){
            //Compile time error - should not contain static method
        }
    }
}
```

Key Points of Member Inner Class

- Both static and non-static members of outer class can access from inside the member inner class.

```
class Outer {
    int i;
    static int j;

    void m1() {
        System.out.println("Non-static Method!");
    }
    static void m2() {
        System.out.println("static Method!");
    }
    class Inner {
        void methodOfInner() {
            m1();
            m2();
        }
    }
}
```

From Next Class

Member Inner Class–Abstract / Final

- Member inne class

```
class Outer {
    abstract class InnerOne {
        // abstract inner class
    }
    final class InnerTwo {
        // final inner class
    }
}
```

Local Inner Class

- A class created inside a method is called local inner class in java
- If we want to invoke the methods of local inner class, we must instantiate this class inside the method
- Local Inner Class is not a member class of any other class
- Its declaration is not directly within the declaration of the outer class
- Local Inner Class can be declared inside particular block of code and its scope is within the block

Local Inner Class – with local variable

```
class Outer{
        private int data=30; //instance variable
        void display(){
                int value=50; //local variable
                class Local {
                        void msg(){
                                System.out.println("Value is: " + value);
                        }
                }
                Local l = new Local();
                l.msg();
        }
        public static void main(String args[]){
                Outer obj = new Outer();
                obj.display();
        }
}
```

Anonymous Inner Classes

- A class which does not have name is called as anonymous inner class. Anonymous class can be created using two methods :
  - By using the interface
  - By using the abstract class
- Anonymous Inner Classes are used for writing an interface implementation

- **Properties:**
  - Has no name
  - Can be instantiated only once
  - Is usually declared inside a method or a code block, a curly braces ending with semicolon.
  - Is accessible only at the point where it is defined.
  - Does not have a constructor simply because it does not have a name
  - Cannot be static

Anonymous IC - Example

```
interface Writable {
        void write(String msg);
}

public class CodeTester {
        public static void main(String[] args) {
                Writable w1 = new Writable() {
                        public void write(String msg){
                                System.out.println(msg);
                        }
                };
                // Note the semicolon
                w1.write("Writing Diary");
        }
}
```

Anonymous IC as argument

```
Interface Message{
        String welcome();
}
public class CodeTester {
        public void showMessage(Message m) {
                System.out.println(m.welcome());
        }
        Public static void main(String args[]) {
                CodeTester ct = new CodeTester();
                ct.showMessage(new Message() {
                        public String welcome() {
                                return "Welcome Folks!!";
                        }
                });
        }
}
```

Returning Object from Method

```
Class Employee {
    double salary, incentive;
    Employee (double salary) {
        this.salary = salary;
    }
    Employee updateSalary(double incentive) {
        Employee emp = new Employee(this.salary + incentive);
        return emp;
    }
    double getSalary() {
        return this.salary;
    }
}
```

Main method

```
Class Checker {
    public static void main (String args[]) {
        Employee ram = new Employee(24,856.38);
        Employee anand;
        anand = ram.updateSalary(6259.67);

        System.out.print("Ram's Salary = " + ram.getSalary());
        System.out.print("Anand's Salary = " +
anand.getSalary());
    }
}
```

Create Object using Inner Class

```
class Circle {
    double x, y, r;
}
class CreateCircle {
    Circle createCicle() {
        return new Circle();
    }
}
class CodeTester {
    public static void main(String[] args) {
        CreateCircle cc = new CreateCircle();
        Circle c1 = cc.createCicle();
        c1.x = 3.0;   c1.y = 5.0;   c1.r = 5.0;
        System.out.println("x =  " + c1.x + ", y =  " + c1.y
                                    + " , r =  " + c1.r);
    }
}
```

Exercise - 6

- **Apply the Concepts of Nested Classes for**
  - Solving Complex Problems
  - Try examples in each category of inner classes
  - Create interfaces and implement the same with your own logics for a specific problem
    - For example, create **Printable** Interface and implement it with your logics that could print the output in user preferred colors of RGB coordinate.

Assignments / Penalties

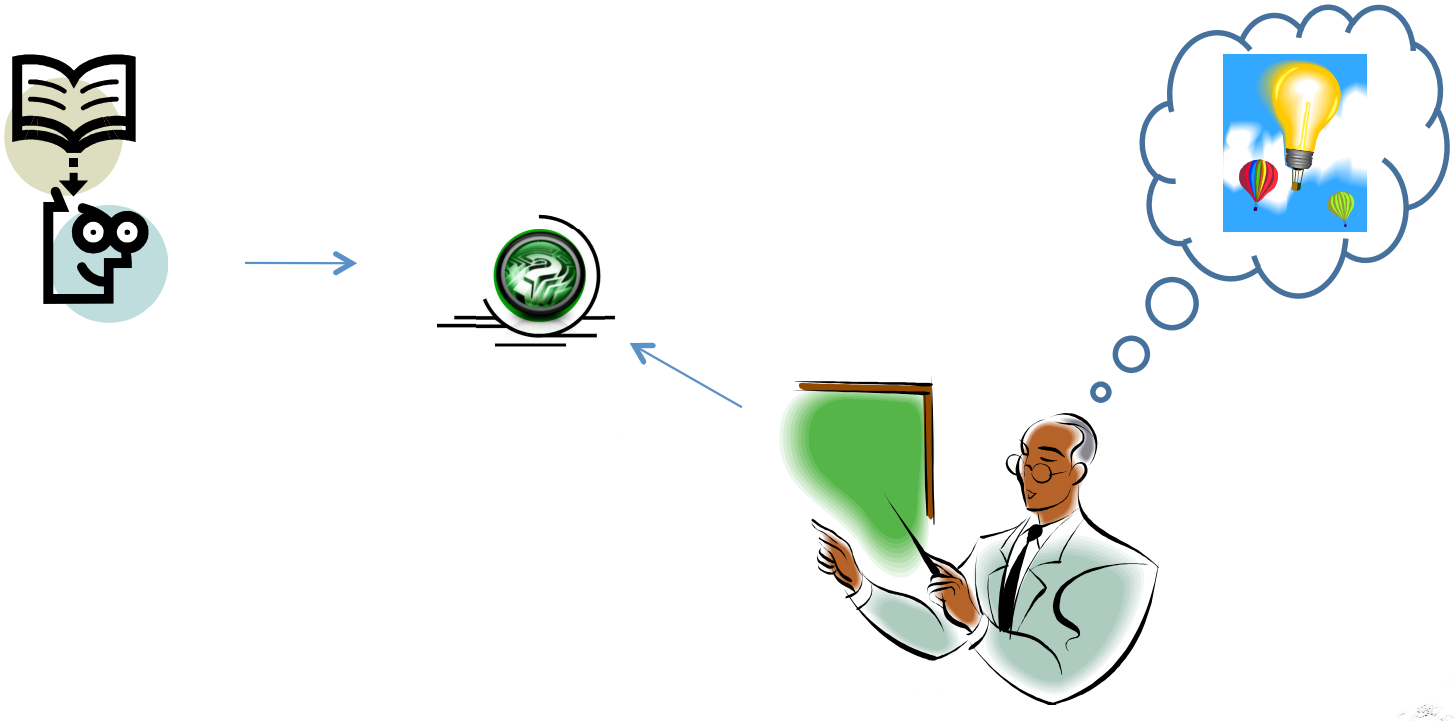
- Every Student is expected to complete the assignments and strictly follow a fair Academic Code of Conduct to avoid severe penalties

- Penalties would be heavy for those who involve in:
  - **Copy and Pasting** the code
  - **Plagiarism** (copied from your neighbor or friend – in this case, both will get "0" marks for that specific take home assignments)
  - If the candidate is **unable to explain his own solution**, it would be considered as a "copied case" !!
  - **Any other unfair means** of completing the assignments

Assistance

- You may post your questions to me at any time
- You may meet me in person on available time or with an appointment
- You may leave me an email any time
  (email is the best way to reach me faster)

Thanks …



… Questions ???