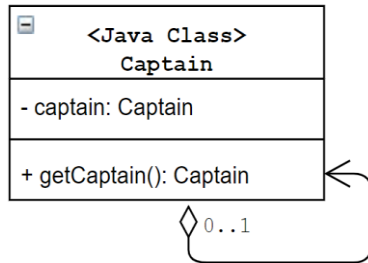


Design Patterns

Singleton Pattern

- It can keep having a single instance rather than multiple.
- It is suitable in a centralized system to restrict unnecessary object creations.



```
package singleton;

// We need a final class to prevent the loose hole 1
// final class Captain {
class Captain {
    static int numberOfInstance=0;
    private static Captain captain; // it will proceed Lazy initialization
    // or
    // private static final Captain captain = new Captain(); // Early initialization and thread safe

    // private is to prevent multiple instance creation
    private Captain() {
        numberOfInstance++;
        System.out.println("Number of instances at this moment=" + numberOfInstance);
    }

    public static synchronized Captain getCaptain() {
        // Lazy initialization
        if(captain == null) {
            captain = new Captain();
            System.out.println("New captain is elected for your team.");
        }
        else {
            System.out.println("You already have a captain for your team.");
        }
        return captain;
    }
}
```

```

// a static dummy method
public static void dummyMethod() {
    System.out.println("It is a dummy method");
}

// inner a non-static nested class
public class CaptainDerived extends Captain {
    //Some code
}
}

public class SingletonPatternExample {

    public static void main(String[] args) {
        System.out.println("***Singleton Pattern Demo***\n");
        System.out.println("Trying to make a captain for your team:");

        // Constructor is private. We cannot use "new" here.
        // Captain c3 = new Captain(); // error

        Captain captain1 = Captain.getCaptain();
        System.out.println("Trying to make another captain for your team:");
        Captain captain2 = Captain.getCaptain();

        if (captain1 == captain2) {
            System.out.println("captain1 and captain2 are same instance.");
        }

        // loose hole 1: it will trigger to the constructor method of parent class again
        Captain.CaptainDerived derived = captain1.new CaptainDerived();

        // loose hole 2: it will trigger to the constructor method without intention
        Captain.dummyMethod();
    }
}

```

Solutions of above loose hole 2:

Solution 1: Bill Pugh's Solution

- It uses a static nested helper class
- It does not use synchronization technique and eager initialization

```
class Captain1 {
    private Captain1() {
        System.out.println("A captain is elected for your team.");
    }

    // Bill Pugh solution
    private static class SingletonHelper {
        /*Nested class is referenced after getCaptain() is called*/
        private static final Captain1 captain = new Captain1();
    }

    public static Captain1 getCaptain() {
        return SingletonHelper.captain;
    }

    public static void dummyMethod() {
        System.out.println("It is a dummy method");
    }
}
```

Solution 2: Double-Checked Locking

Double-checked locking is the practice of checking a lazy-initialized object's state both before and after a synchronized block is entered to determine whether or not.

```
final class Captain2 {
    private static Captain2 captain;

    //We make the constructor private to prevent the use of "new"

    static int numberOfInstance=0;

    private Captain2() {
        numberOfInstance++;
    }
}
```

```

        System.out.println("Number of instances at this moment="+
        numberOfInstance);
    }
    public static Captain2 getCaptain(){
        if (captain == null) {
            synchronized (Captain2.class) { // it is better for performance using inside if-then-else condition
                // Lazy initialization
                if (captain == null){
                    captain = new Captain2();
                    System.out.println("New captain is elected for your team.");
                }
                else {
                    System.out.print("You already have a captain for your team.");
                    System.out.println("Send him for the toss.");
                }
            }
        }
        return captain;
    }
}

```