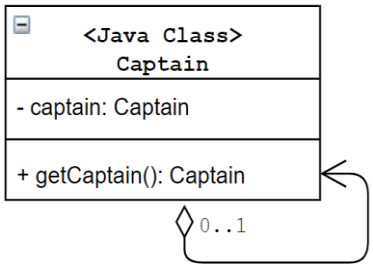
Design Patterns

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 private 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;
  }
}
```