Printing Foo Bar n Times

Learn how to execute threads in a specific order for a user specified number of iterations.

Problem

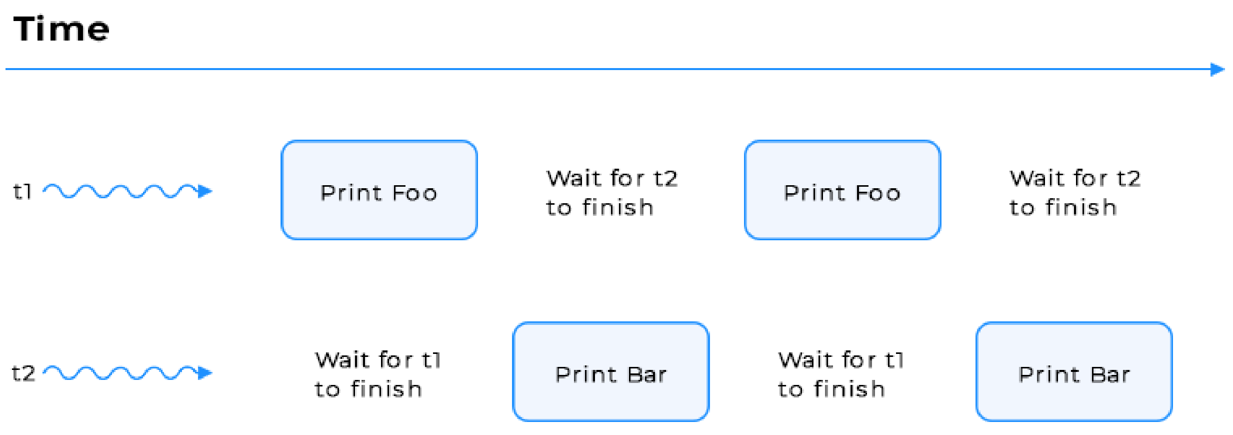
Suppose there are two threads t1 and t2. t1 prints **Foo** and t2 prints **Bar**. You are required to write a program which takes a user input n. Then the two threads print Foo and Bar alternately n number of times. The code for the class is as follows:

```
class PrintFooBar {

    public void PrintFoo() {
        for (int i = 1 i <= n;  i++){
        System.out.print("Foo");
        }
    }

    public void PrintBar() {
        for (int i = 1; i <= n; i++) {
        System.out.print("Bar");
        }
    }
}
```

The two threads will run sequentially. You have to synchronize the two threads so that the functions PrintFoo() and PrintBar() are executed in an order. The workflow is shown below:



Workflow

Solution

We will solve this problem using the basic utilities of `wait()` and `notifyAll()` in Java. The basic structure of `FooBar` class is given below:

```java
class FooBar {
    private int n;
    private int flag = 0;

    public FooBar(int n) {
        this.n = n;
    }

    public void foo() {
    }

    public void bar() {
    }
}
```

Two private instances of the class are integers `n`, and `flag`.

`n` is the user input that tells how many times "Foo" and "Bar" should be printed. `flag` is an integer based on which the words are printed. When the value of `flag` is 0, the word "Foo" will be printed and it will be incremented. This way "Bar" can be printed next. `flag` is initialized with

0 because the printing has to start with "Foo". The class consists of two methods `foo()` and `bar()` and their structures are given below:

```
public void foo() {

        for (int i = 1; i <= n; i++) {
            synchronized(this) {
                while (flag == 1) {
                    try {
                        this.wait();
                    }
                    catch (Exception e) {
                    }
                }
                System.out.print("Foo");
                flag = 1;
                this.notifyall();
            }
        }
}
```

In `foo()`, a loop is iterated `n` (user input) number of times. For synchronization purpose, the printing operation is locked in `synchronize(this)` block. This is done to ensure proper sequence of printing. If `flag` is 0 then “Foo” is printed, then `flag` is set to 1 and any waiting threads are notified via `notifyAll()`. While the value of `flag` is 1, then `wait()` blocks the calling thread.

```
public void bar() {

        for (int i = 1; i <= n; i++) {
            synchronized(this) {
                while (flag == 0) {
                    try {
                        this.wait();
                    }
                    catch (Exception e) {
                    }
                }
                System.out.print("Bar");
                flag = 0;
                this.notifyAll();
            }
        }
}
```

Similarly in `bar()`, the loop is iterated `n` times. In every iteration, the while loop checks if the value of `flag` is 0. If it is, then it means it is not yet bar's turn to be printed and the calling thread will `wait()`. When the value of `flag` changes to 1, the waiting thread can resume execution. "Bar" is printed and `flag` is changed to 0 for "Foo" to be printed next. All the waiting threads are then notified via `notifyAll()` that this thread has finished its work.

We will create a new class `FooBarThread` that extends Thread. This enables us to run `FooBar` methods in separate threads concurrently. The class consists of a `FooBar` object along with a string `method` which holds the name of the function to be called. If `method` matches "foo" then `fooBar.foo()` is called. If `method` matches "bar", then `fooBar.bar()` is called.

```
class FooBarThread extends Thread {

    FooBar fooBar;
    String method;

    public FooBarThread(FooBar fooBar, String method){
        this.fooBar = fooBar;
        this.method = method;
    }

    public void run() {
        if ("foo".equals(method)) {
           fooBar.foo();
        }
        else if ("bar".equals(method)) {
           fooBar.bar();
        }
    }
}
```

To test our code, We will create two threads; **t1** and **t2**. An object of `FooBar` is initialized with `3`. Both threads will be passed the same object of `FooBar`. **t1** calls `foo()` & **t2** calls `bar()`.

```
class FooBar {

    private int n;
    private int flag = 0;

    public FooBar(int n) {
        this.n = n;
    }

    public void foo() {

        for (int i = 1; i <= n; i++) {
            synchronized(this) {
                if (flag == 1) {
                    try {
                        this.wait();
                    }
                    catch (Exception e) {

                    }
                }
                    System.out.print("Foo");
                flag = 1;
                this.notifyAll();
            }
        }
    }

    public void bar() {

        for (int i = 1; i <= n; i++) {
            synchronized(this) {
                while (flag == 0) {
                    try {
                        this.wait();
                    }
                    catch (Exception e) {

                    }
                }
                System.out.println("Bar");
                flag = 0;
                this.notifyAll();
            }
        }
    }
}


class FooBarThread extends Thread {

    FooBar fooBar;
    String method;

    public FooBarThread(FooBar fooBar, String method){
        this.fooBar = fooBar;
        this.method = method;
    }

    public void run() {
        if ("foo".equals(method)) {
           fooBar.foo();
        }
        else if ("bar".equals(method)) {
           fooBar.bar();
        }
    }
}


public class Main {

    public static void main(String[] args) {

            FooBar fooBar = new FooBar(3);

            Thread t1 = new FooBarThread(fooBar,"foo");
            Thread t2 = new FooBarThread(fooBar,"bar");

            t2.start();
            t1.start();

    }
}
```