

PA 1

<https://github.com/comp346/W15>

Objectives

- Explain the specification
- Multiple threading
- Issues without Synchronization
- Simple solution

Setup

1. Create a new project
2. Extract the provided file
3. Copy java files to your project
4. Run

What are inside?

- Account
- Depositor
- Withdrawer
- AccountManager

Account's Properties

Account Number, Name & Balance. Balance can be changed.

Account's Behaviors

- Open or create account
- Deposit
- Withdraw
- Check balance

Account Skeleton

```
class Account {  
    private int accountID;  
    private String name;  
    private double balance;  
  
    //Skeleton  
    public Account(int acc, String name, double balance) { ??? }  
    public void deposit(double amount) { ??? }  
    public void withdrawn(double amount) { ??? }  
    public double getBalance() { ??? }  
    public String toString() { ??? }  
}
```

Inheritance

Dove can inherit general properties of a bird: fly, eat ...

```
public class Dove extends Bird {  
  
}
```

A bird can inherit from an animal ...

```
public class Bird extends Animal {  
  
}
```

Hierrachy

Every class in java either is inherited directly or indirectly from Object

Thread is an execution that executes a **given task** concurrently with other threads.

```
class CustomTask extends Thread {  
    public void run { ??? }  
}
```

Create a thread then call start

```
CustomTask t = new CustomTask();  
t.start();
```

Depositor is an execution which executes **deposit N times** to a given account.

```
public class Depositor extends Thread {  
    private Account account;  
  
    public Depositor(Account account) {  
        this.account = account;  
    }  
  
    public void run() {  
        for(int i = 0; i < times; i++) {  
            account.deposit(amount);  
        }  
    }  
}
```

Withdrawer is an execution which executes **withdraw N times** to a given account.

```
public class Withdrawer extends Thread {  
    private Account account;  
  
    public Depositor(Account account) {  
        this.account = account;  
    }  
  
    public void run() {  
        for(int i = 0; i < times; i++) {  
            account.withdraw(amount);  
        }  
    }  
}
```

Account Manager

1. Application Entry - has static void main method
2. Create 10 accounts
3. Print out balances
4. Each account, create 1 depositor and 1 withdrawer
5. Start all depositors and withdrawers
6. Waits for all finished
7. Print out balance

```
public class AccountManager {
    public static void main(String[] args) {
        int n = 10;
        //Create and initialize accounts
        Account[] accounts = new Account[n];
        accounts[0] = new Account(1234, "Mike", 1000);
        accounts[9] = new Account(9999, "Alex", 2000);
        for(int i = 0; i < n; i++){
            System.out.println(accounts[i]);
        }

        //Depositors and withdrawers
        Depositor[] ds = new Depositor[n];
        Withdrawer[] ws = new Withdrawer[n];
        for(int i = 0; i < n; i++) {
            ds[i] = new Depositor(accounts[i]);
            ws[i] = new Withdrawer(accounts[i]);
        }
        //More to come
    }
}
```

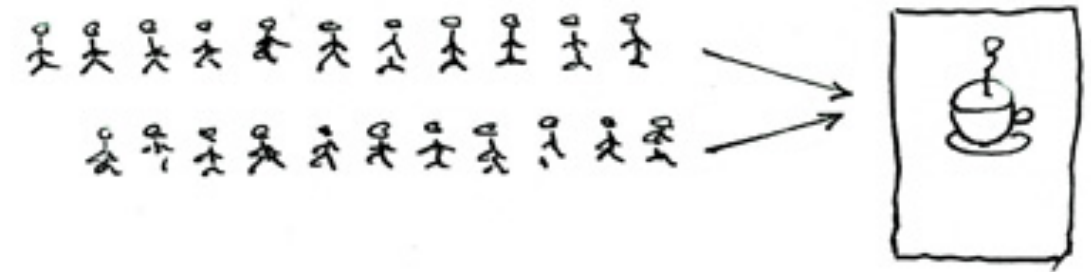
```
public class AccountManager {
    public static void main(String[] args) {
        int n = 10;
        // .. Omitted step 2, 3 and 4
        for(int i = 0; i < n; i++) {
            ds[i].start();
            ws[i].start();
        }
        //Waits for finish
        for(int i = 0; i < n; i++) {
            ds[i].join();
            ws[i].join();
        }
        //Check balance again
        for(int i = 0; i < n; i++){
            System.out.println(accounts[i]);
        }
    }
}
```

Re-run the application

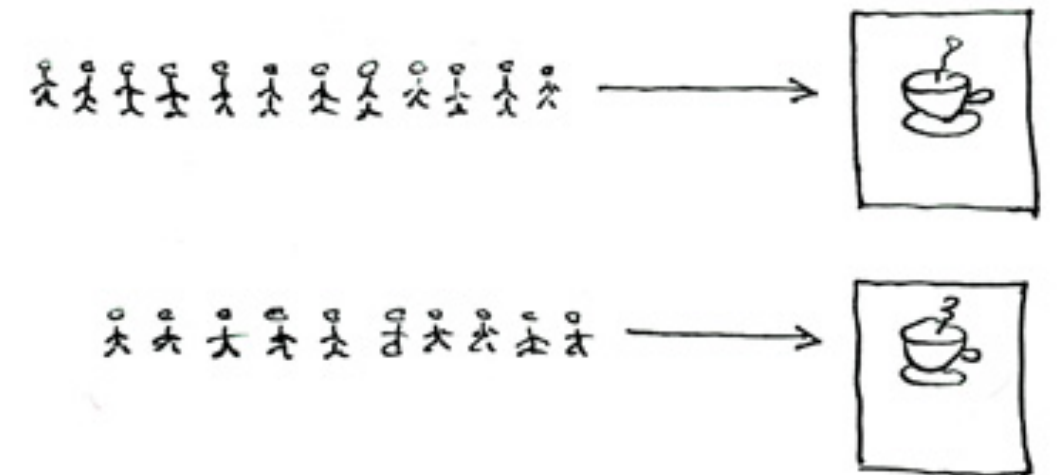
1. Remember the balance of the first account
2. Is it the same as the initialized balance ?
3. Re-run once more, is it the same as the previous steps.

**What happens if both
lines approach at the
same time?**

Concurrent = Two Queues One Coffee Machine



Parallel = Two Queues Two Coffee Machines



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Race condition

```
public class UnsafeSequence {  
    private int value = 0;  
    public int getNext() {  
        return value++;  
    }  
}
```

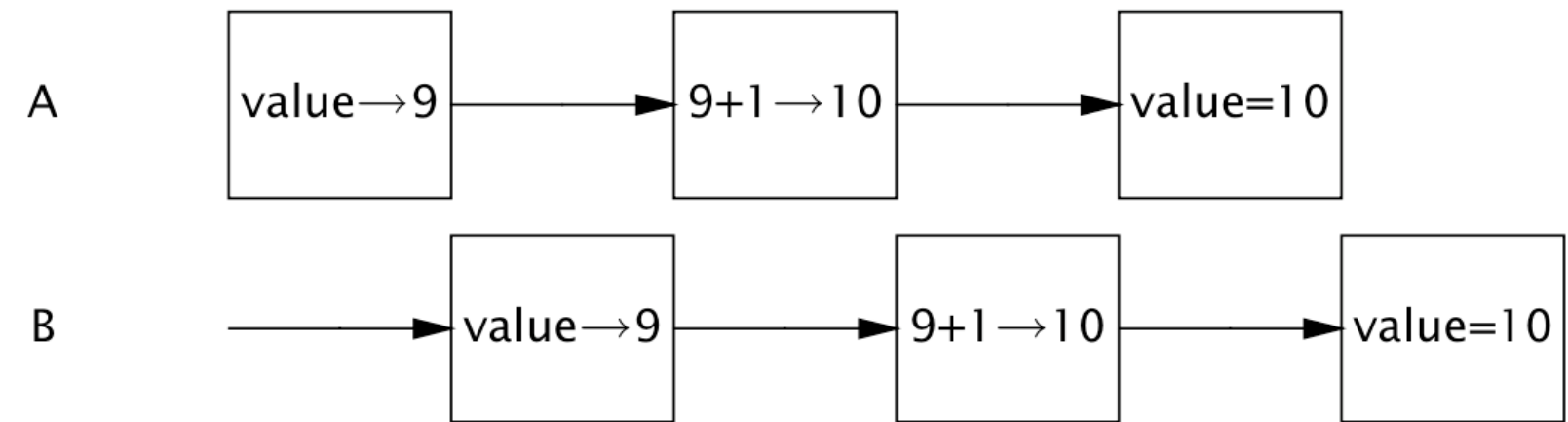


FIGURE 1.1. Unlucky execution of `UnsafeSequence.getNext`.

Synchronized (Intrinsic Lock)

Only one thread is allowed to enter a method or a block of statements.

```
public class SynchronizedSequence {  
    private int value;  
    public synchronized int getNext() {  
        return value++;  
    }  
}
```

<http://docs.oracle.com/javase/tutorial/essential/concurrency/locksinc.html>

Package

- Group of related classes (Example `System.out.println()`)
- Create package
- Import package

Task & Submission

Please refer the specification

Thank you