Practice of Programming using Java
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Threads

A *Thread* is a unit of concurrency

For example: A thread sends a flow into a tank, whereas, another thread takes out the liquid

Specifying Threads

```
Class MyThread extends Thread {

...
…
public void run ( ) {…. };
…
}
```

Starting a Thread and the run () method

To start a thread, send start() message to a thread object

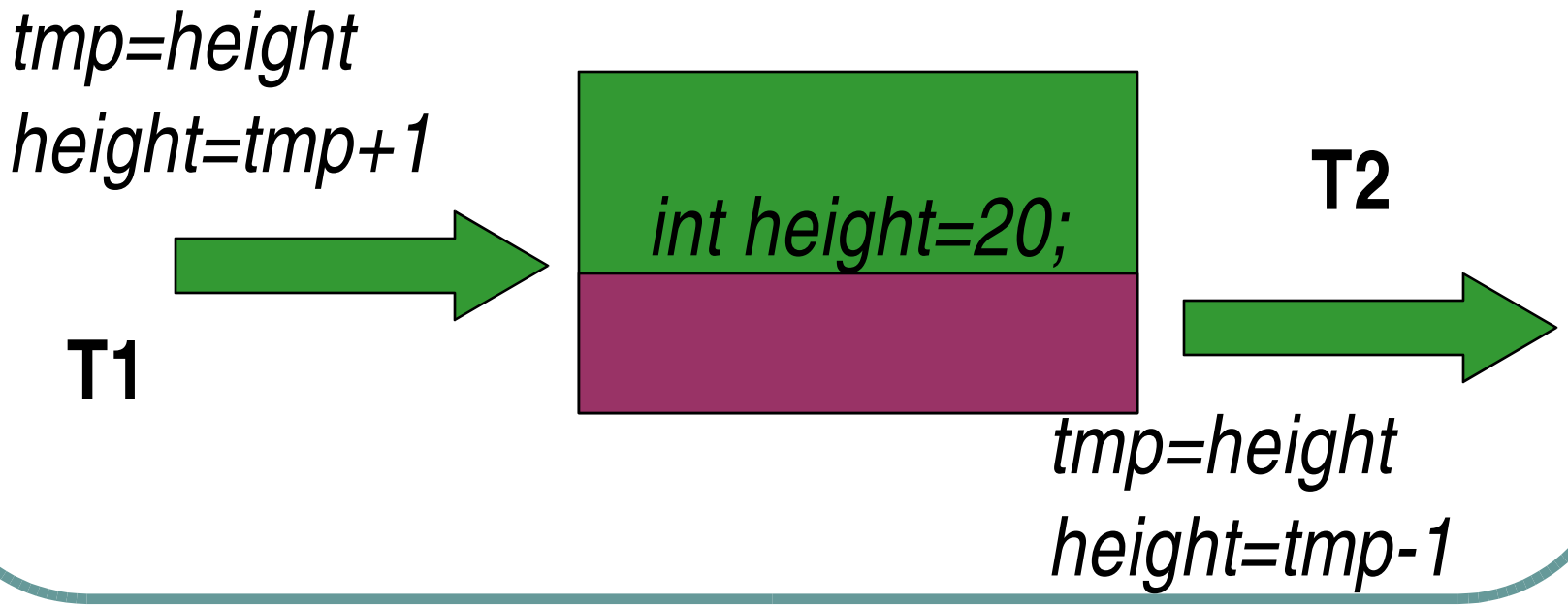
For example:

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

The run() method starts executing concurrently while start() returns in the calling thread. When run() completes, the thread terminates

Synchronization Problems

What if two threads invoke methods on a shared object?



Synchronized Methods

Declare a method as *synchronized* to guarantee mutually exclusize execution on an object

An invocation of a synchronized method locks the object and another synchronized method cannot execute when the object is locked.

```
class A {
private int value;
public synchronized readVal () {return value;}
public synchronized incrVal() {value=value+1;}
… }
```

Threads: An Example

```
public class PingPong extends Thread {
private String word;
private int d;
public  PingPong (String whatToSay, int delayTime) {
        word = whatToSay;
        d = delayTime;
    }
```

```
public  void run ( ) {
    try {
            while (true) {
                    System.out.println (word + "\n");
                    sleep (d);
            }
        }
    catch (InterruptedException e) {
            System.out.println ("exception occured\n");
            return;                 // end this thread
    }
    }
```

```
public  static void main (String[] args) {
        PingPong T1 = new PingPong (”Ping", 1000);
        PingPong T2 = new PingPong (”Pong", 500);

        System.out.println ("main thread starts");
        T1.start () ;
        T2.start () ;
        System.out.println ("main thread ends");
    }
}
```

Synchronized Statements

```
Class X {

    public f() {
            …
            synchronized (anObj) {
                    .. some code C..
            }
    }
```

Code C executes once anObj is locked

Wait and Notify

A thread can wait for a condition to occur by calling wait()

- The thread waits on an object's monitor
- A wait automatically unlocks the monitor object
- Locking can occur through synchronized methods

Another thread, the owner of the object's monitor can wakeup a waiting thread by sending it a notify() message

- If a thread is executing a synchronized method on the object, synchronized statement on the object, synchronized static method, it becomes owner of that object's monitor.

```
synchronized void someFunc() {
 while (somecondition) wait();
  ... program logic ..
}
```

Wait and Notify..

wait(long timeout): waits till a notification or till timeout (in ms) expires

wait (long timeoutMs, int timeoutNanoSec): A fine grained wait (ms+ns)

notify(): notifies at most one thread that is waiting

notifyAll(): notifies all threads that are waiting

Some Scheduling Aspects

sleep(long ms) : the exeuting thread sleeps for given milliseconds

sleep (long ms, int ns) : fine grain sleep

yield () : the executing thread yields so that other thread which is ready to run can run. It generates an explicit context switch between threads

Runnable Interface

Runnable is an interface that exports method:

public void run()

A class can implement the run() method by inheriting the interface, instead of inheriting from class Thread

- possible to use multiple inheritance

- overheads of Thread class are avoided if the class needs only to be runnable

A Thread object can be created from a runnable object