เรื่องที่ 13 Inner class & Outer class และ Thread

ENGCE174 การเขียนโปรแกรมเชิงวัตถุ (Object-oriented programming)

อ.กิตตินันท์ น้อยมณี (mr.kittinan@rmutl.ac.th)

Java Inner Classes

In Java, it is also possible to nest classes (a class within a class). The purpose of nested classes is to group classes that belong together, which makes your code more readable and maintainable.

To access the inner class, create an object of the outer class, and then create an object of the inner class:

```java
class OuterClass {
  int x = 10;

  class InnerClass {
    int y = 5;
  }
}

public class Main {
  public static void main(String[] args) {
    OuterClass myOuter = new OuterClass();
    OuterClass.InnerClass myInner = myOuter.new InnerClass();
    System.out.println(myInner.y + myOuter.x);
  }
}

// Outputs 15 (5 + 10)
```

Private Inner Class

Unlike a "regular" class, an inner class can be `private` or `protected`. If you don't want outside objects to access the inner class, declare the class as `private`:

```java
class OuterClass {
  int x = 10;

  private class InnerClass {
    int y = 5;
  }
}

public class Main {
  public static void main(String[] args) {
    OuterClass myOuter = new OuterClass();
    OuterClass.InnerClass myInner = myOuter.new InnerClass();
    System.out.println(myInner.y + myOuter.x);
  }
}
```

If you try to access a private inner class from an outside class, an error occurs:

```
Main.java:13: error: OuterClass.InnerClass has private access in OuterClass
    OuterClass.InnerClass myInner = myOuter.new InnerClass();
```

Static Inner Class

An inner class can also be `static`, which means that you can access it without creating an object of the outer class:

Note: just like `static` attributes and methods, a `static` inner class does not have access to members of the outer class.

```
class OuterClass {
  int x = 10;

  static class InnerClass {
    int y = 5;
  }
}

public class Main {
  public static void main(String[] args) {
    OuterClass.InnerClass myInner = new OuterClass.InnerClass();
    System.out.println(myInner.y);
  }
}

// Outputs 5
```

Access Outer Class From Inner Class

One advantage of inner classes, is that they can access attributes and methods of the outer class:

```
class OuterClass {
  int x = 10;

  class InnerClass {
    public int myInnerMethod() {
      return x;
    }
  }
}

public class Main {
  public static void main(String[] args) {
    OuterClass myOuter = new OuterClass();
    OuterClass.InnerClass myInner = myOuter.new InnerClass();
    System.out.println(myInner.myInnerMethod());
  }
}

// Outputs 10
```

Java Threads

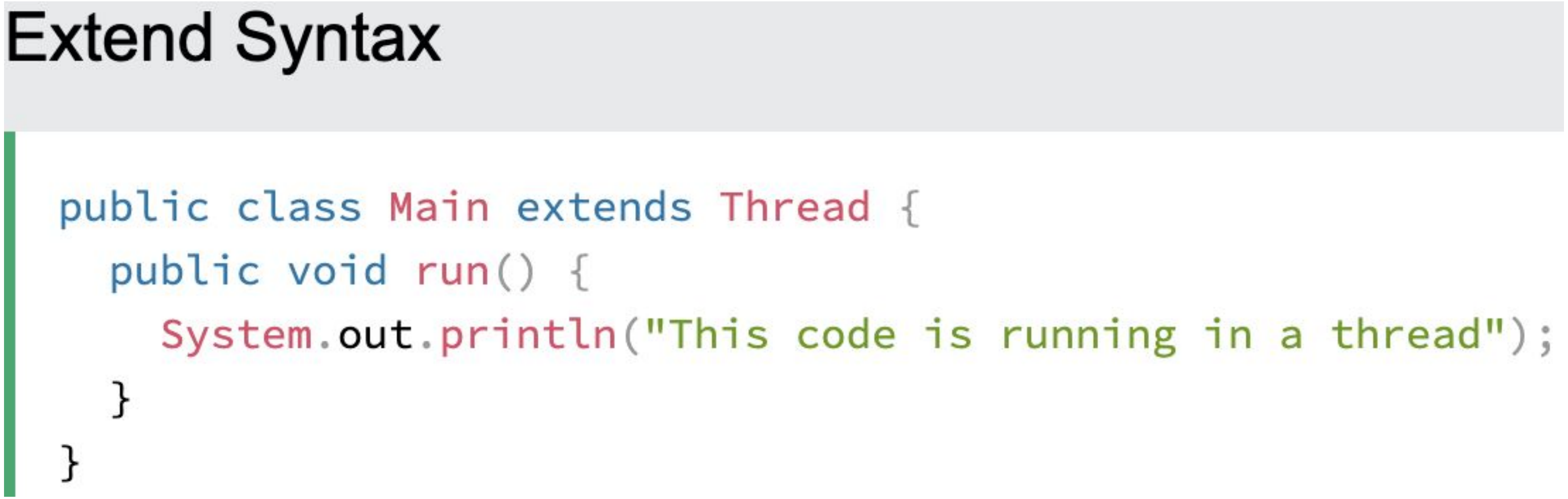
Threads allows a program to operate more efficiently by doing multiple things at the same time.

Threads can be used to perform complicated tasks in the background without interrupting the main program.

Creating a Thread

There are two ways to create a thread.

It can be created by extending the `Thread` class and overriding its `run()` method:

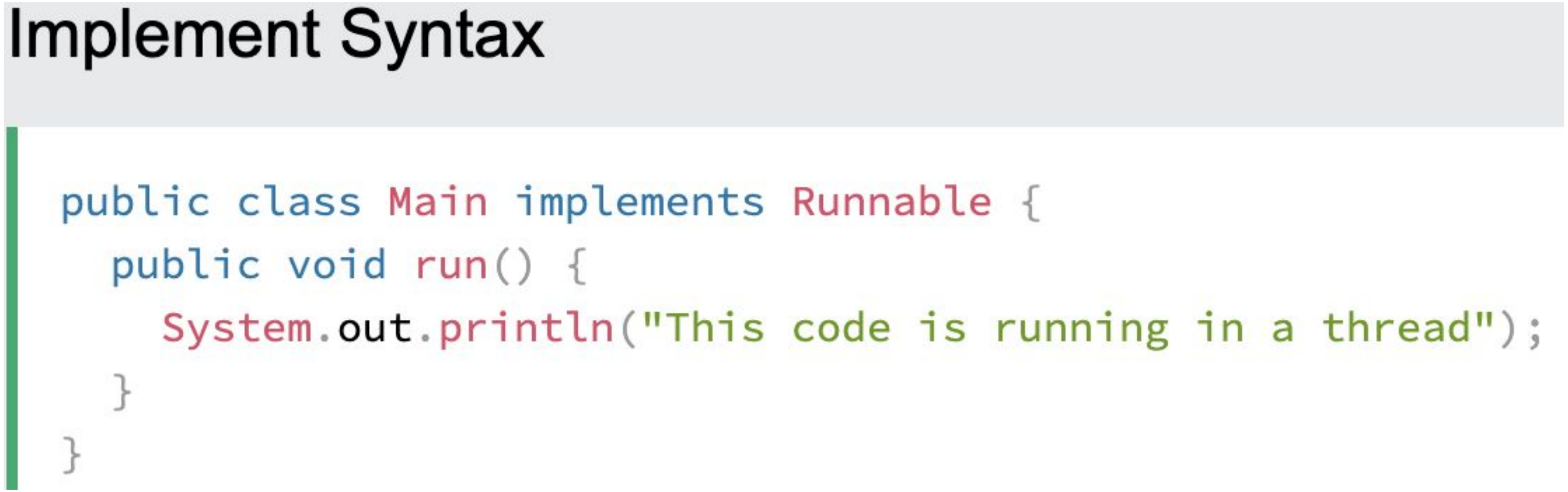


Extend Syntax

```
public class Main extends Thread {
  public void run() {
    System.out.println("This code is running in a thread");
  }
}
```

Creating a Thread

Another way to create a thread is to implement the `Runnable` interface:

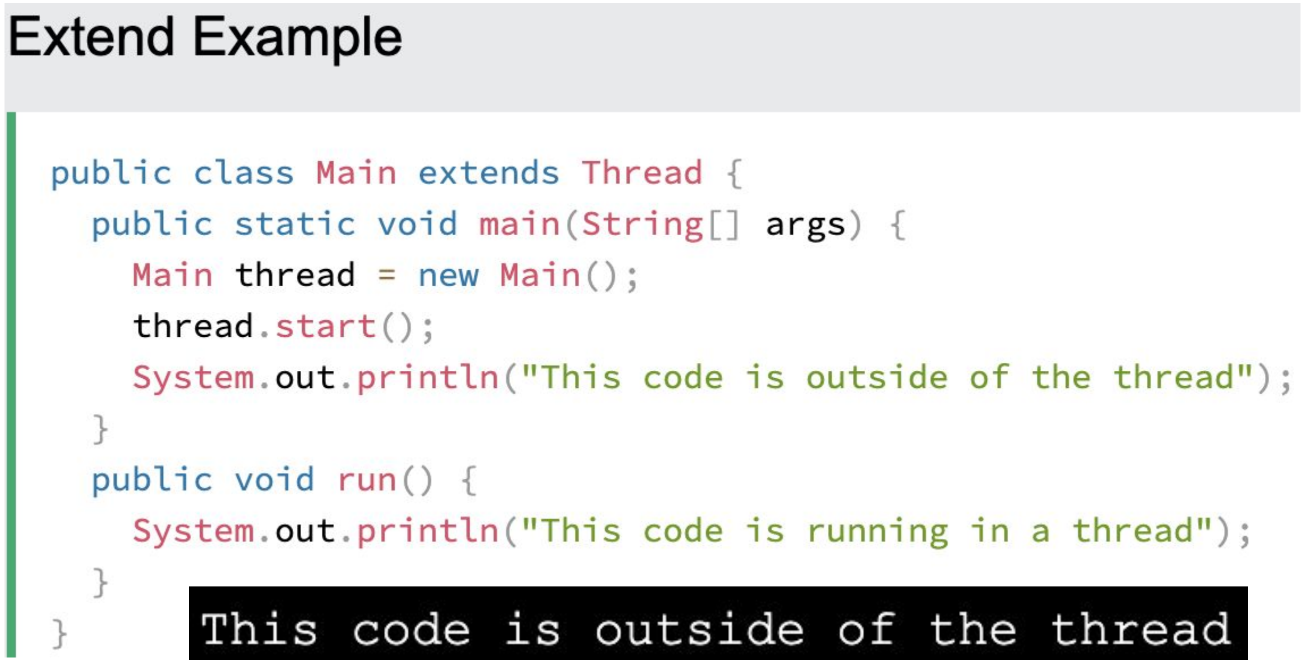


Implement Syntax

```java
public class Main implements Runnable {
  public void run() {
    System.out.println("This code is running in a thread");
  }
}
```

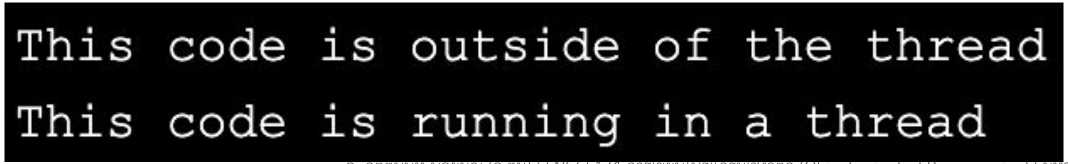
Running Threads

If the class extends the `Thread` class, the thread can be run by creating an instance of the class and call its `start()` method:



Extend Example

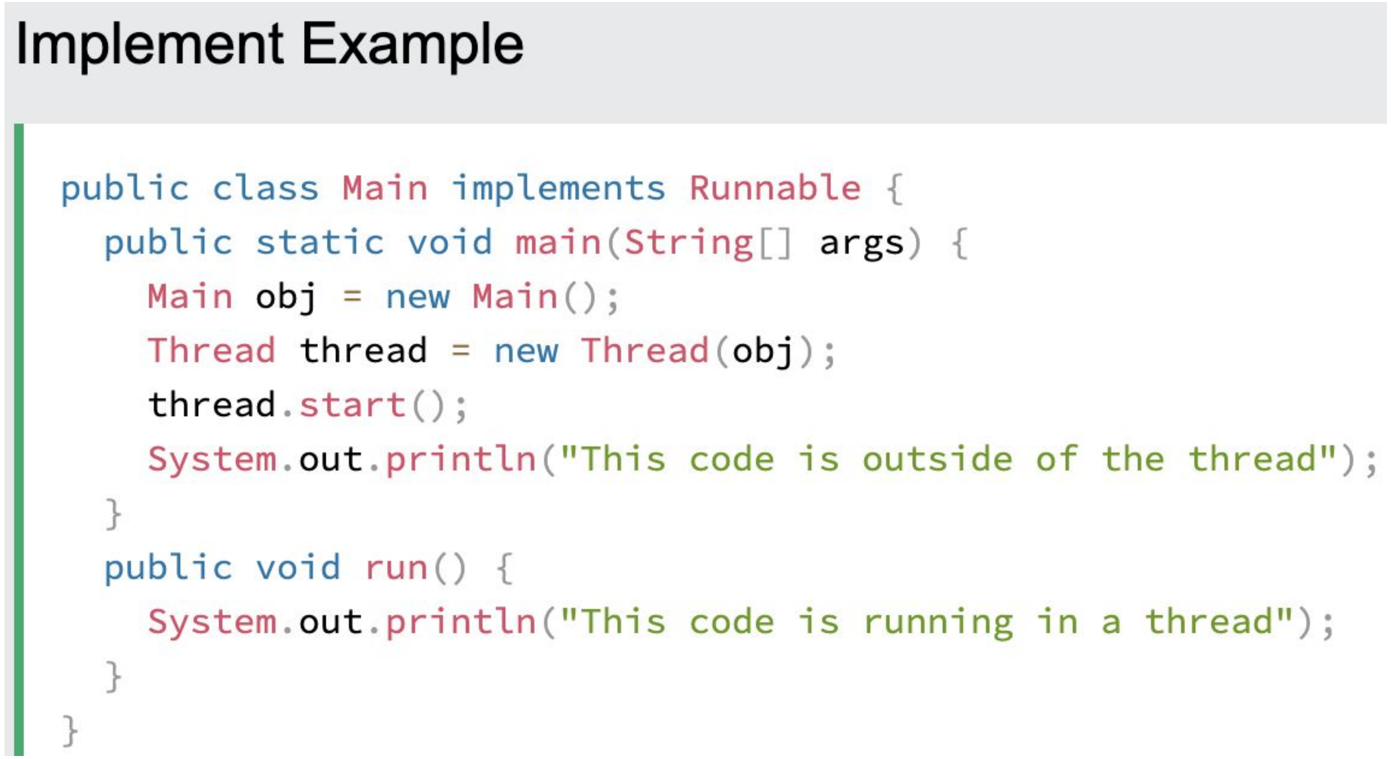
```java
public class Main extends Thread {
  public static void main(String[] args) {
    Main thread = new Main();
    thread.start();
    System.out.println("This code is outside of the thread");
  }
  public void run() {
    System.out.println("This code is running in a thread");
  }
}
```



```
This code is outside of the thread
This code is running in a thread
```

Running Threads

If the class implements the `Runnable` interface, the thread can be run by passing an instance of the class to a `Thread` object's constructor and then calling the thread's `start()` method:



Implement Example

```java
public class Main implements Runnable {
  public static void main(String[] args) {
    Main obj = new Main();
    Thread thread = new Thread(obj);
    thread.start();
    System.out.println("This code is outside of the thread");
  }
  public void run() {
    System.out.println("This code is running in a thread");
  }
}
```

Running Threads

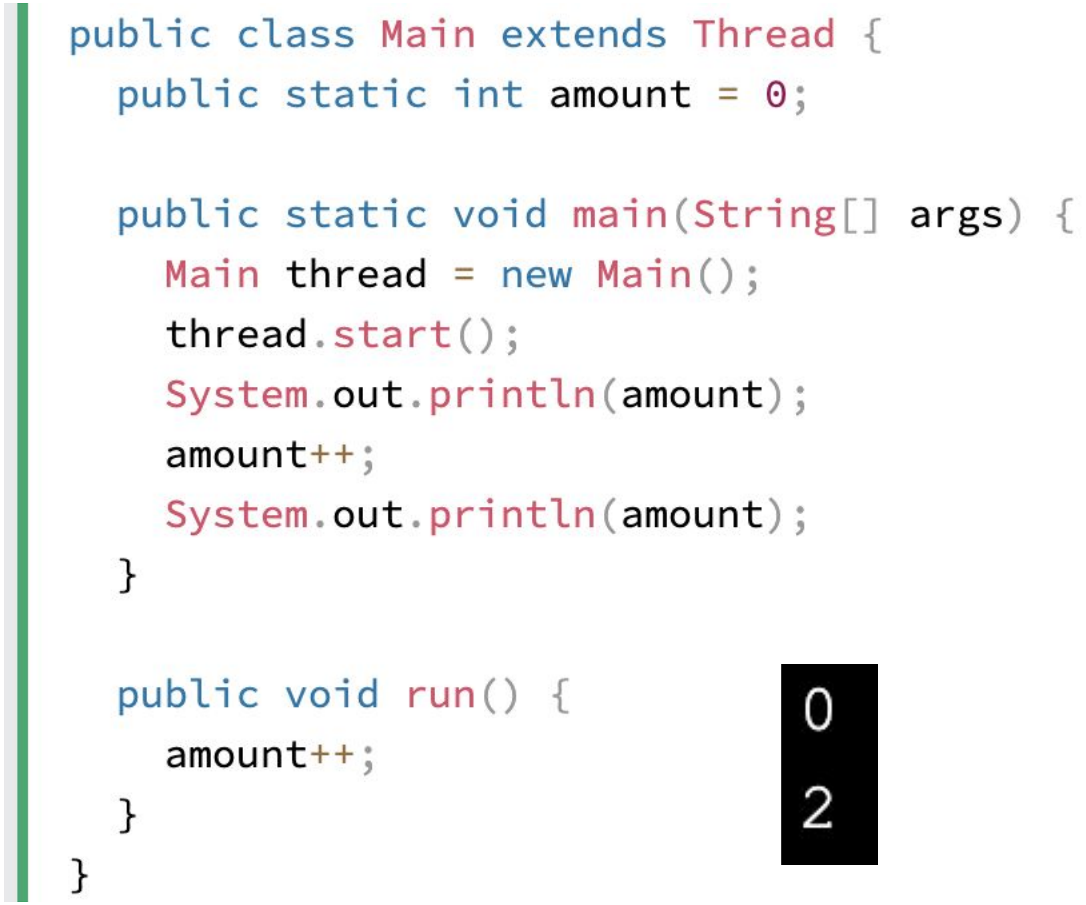
Differences between "extending" and "implementing" Threads

The major difference is that when a class extends the Thread class, you cannot extend any other class, but by implementing the Runnable interface, it is possible to extend from another class as well, like: class `MyClass extends OtherClass implements Runnable`.

Concurrency Problems

Because threads run at the same time as other parts of the program, there is no way to know in which order the code will run. When the threads and main program are reading and writing the same variables, the values are unpredictable. The problems that result from this are called concurrency problems.

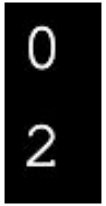
A code example where the value of the variable amount is unpredictable:



```java
public class Main extends Thread {
  public static int amount = 0;

  public static void main(String[] args) {
    Main thread = new Main();
    thread.start();
    System.out.println(amount);
    amount++;
    System.out.println(amount);
  }

  public void run() {
    amount++;
  }
}
```



```
0
2
```

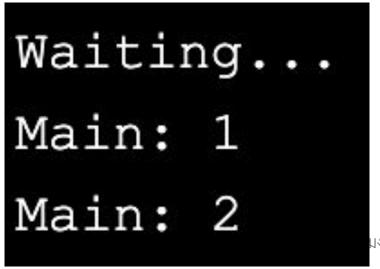
Concurrency Problems

To avoid concurrency problems, it is best to share as few attributes between threads as possible. If attributes need to be shared, one possible solution is to use the `isAlive()` method of the thread to check whether the thread has finished running before using any attributes that the thread can change.

Use `isAlive()` to prevent concurrency problems:

```java
public class Main extends Thread {
  public static int amount = 0;

  public static void main(String[] args) {
    Main thread = new Main();
    thread.start();
    // Wait for the thread to finish
    while(thread.isAlive()) {
    System.out.println("Waiting...");
  }
  // Update amount and print its value
  System.out.println("Main: " + amount);
  amount++;
  System.out.println("Main: " + amount);
  }
  public void run() {
    amount++;
  }
}
```



```
Waiting...
Main: 1
Main: 2
```