



C340 Concurrency: Programming in Java

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What is Java?

- ***OO Programming Language***
- ***C/C++ control statements & expressions***
- ***Automatic garbage collection***
- ***Single inheritance + interfaces***
- ***Concurrent Threads + Monitors***
- ***Standard Packages***
 - ***Graphical User Interface support.***
 - ***Network support.***
 - ***Multi-media support - animation, sound***
 - ***ADTs - Vector, Hashtable, Dictionary etc***



Why is Java interesting?

■ Portability

- *Java programs are compiled into bytecode and are executed by interpreter*
- *Efficiency through JIT bytecode compilers*
- *Java Virtual Machine implementations available for all common platforms (CPU + OS)*
- *Package `java.awt`: portable interface to window systems e.g X11, Windows, Mac OS.*

■ Accessibility

- *Compiled Java programs can be transmitted to and executed on remote computers.*
- *Web browsers execute Java code - Applets.*

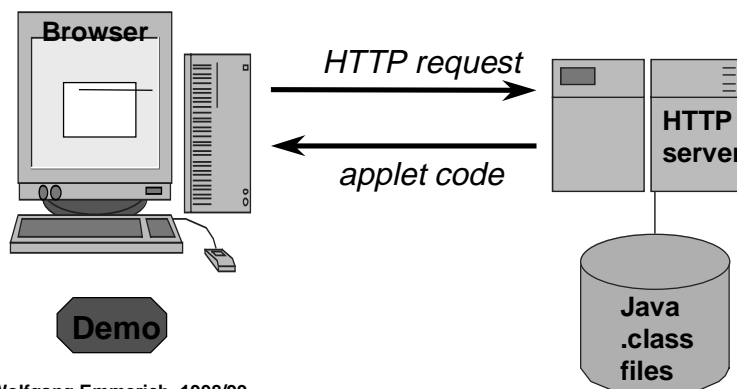
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What is an Applet?

- *Java class derived from application window toolkit (AWT) class `Applet`*
- *Executable by a Web browser.*



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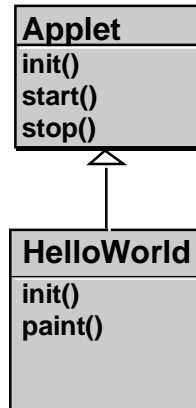


A simple Applet - Hello World

```
import java.awt.*;           //windows toolkit
import java.applet.*;       //applet support
public class HelloWorld extends Applet {
    private Font f1;
    public HelloWorld() {
        f1 = new Font("Helvetica",Font.BOLD,36);
    }
    public void paint(Graphics g) {
        g.setFont(f1);
        g.drawString("Hello World",25,50);
    }
}
```



Hello World - Class diagram





Embedding Applets in HTML

```
<HTML>
<HEAD>
<TITLE> A simple program </TITLE></HEAD>
<BODY>
<H1 ALIGN=CENTER>Hello World</H1>
<CENTER><P>
<APPLET CODE="Hello World.class"
          WIDTH=250
          HEIGHT=150>
</APPLET>
</P></CENTER>
</BODY>
</HTML>
```

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How does Java differ from C/C++?

■ Primitive Datatypes

- boolean, char, byte, short, int, long, float, double.
- boolean *is a 1 bit value* (true, false)
- char *is a 16 bit Unicode character*
- *constants are declared like:*
public final static PI = 3.14159;

■ Derived Types

- *classes & arrays*
- *Instances of derived types handled by reference*
- *primitive types handled by value.*

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Java Classes

- *Single inheritance hierarchy*
- *Rooted in class Object.*

```
class Counter extends Object{
    private int count;
    Counter(int i)
        {count = i;}
    void increment()
        { ++count; }
    void decrement()
        { --count; }
    int value()
        { return count;}
}
```

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Java Interfaces

- *Do not contain any method code*
- *Similar to C++ classes with pure virtual member functions (int a()=0;)*
- *Implemented by other classes that declare implements relationship*
- *Used to implement callbacks*

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Objects & Object References

- **Declaring objects:**

```
Counter a;  
Counter b;
```

- **Creating objects:**

```
a=new Counter(0);  
b=new Counter(1);
```

- **Method invocation:**

```
a.increment();  
b.decrement();
```

a:Counter
count = 0

b:Counter
count = 1



Objects & Object References (cont'd)

- **Identity vs. equality:**

```
(a == b)          // identity test  
(a.equals(b))    // equality test
```

- **Automatic garbage collection:**

```
a = b;           // if a is last ref  
a = null;        // garbage collection  
                 // deletes object after  
                 // these assignments
```



Arrays

- **Arrays are created similarly to objects:**

```
int table[] = new table[128];  
int lookup[] = {1,2,4,8,16,32};
```

- **Arrays have a length field:**

```
for(int i =0; i<table.length; i++)  
    table[i] *= 2; // double
```



Strings

- **Strings are not null terminated arrays of characters:**

```
String a = "Hello";  
String b = "World";  
String message = a + ", " + b;
```

- **A String is immutable**
- **Use StringBuffer to modify the contents of a String**



Further Information

- *Java in a Nutshell* by David Flanagan
O'Reilly & Associates Inc. 1996
- *The Java Tutorial* by Mary Campione and
Kathy Walrath Addison-Wesley, 1996.
<http://www.javasoft.com/>
- *Java API Documentation*
<http://www.javasoft.com/>
- *Concurrency Course using Java*
<http://www-dse.doc.ic.ac.uk/~jnm>



Summary

- *Advantages of Java*
- *Applets vs. Applications*
- *Differences between Java and C++*
- *Classes and Inheritance in Java*
- *Interfaces in Java*
- *Objects and Object References*
- *Arrays*
- *Strings*
- *Next Lecture: Concurrency in Java*