Static Methods and Fields

CSE 142, Summer 2003

Computer Programming 1

http://www.cs.washington.edu/education/courses/142/03su/

Readings and References

- Reading
  - » Appendix C, Section: Static Modifier, *Intro to Programming and Object-Oriented Design Using Java*, Niño and Hosch

- Other References
  - » Sections 8.3.1.1 static Fields and 8.4.3.2 static Methods, *Java Language Specification*, Second Edition

`main` Method

- We need to identify the point where program execution starts
- The Java convention is that we define a static method named **`main`** in at least one class

```
public static void main(String[] args){…}
```

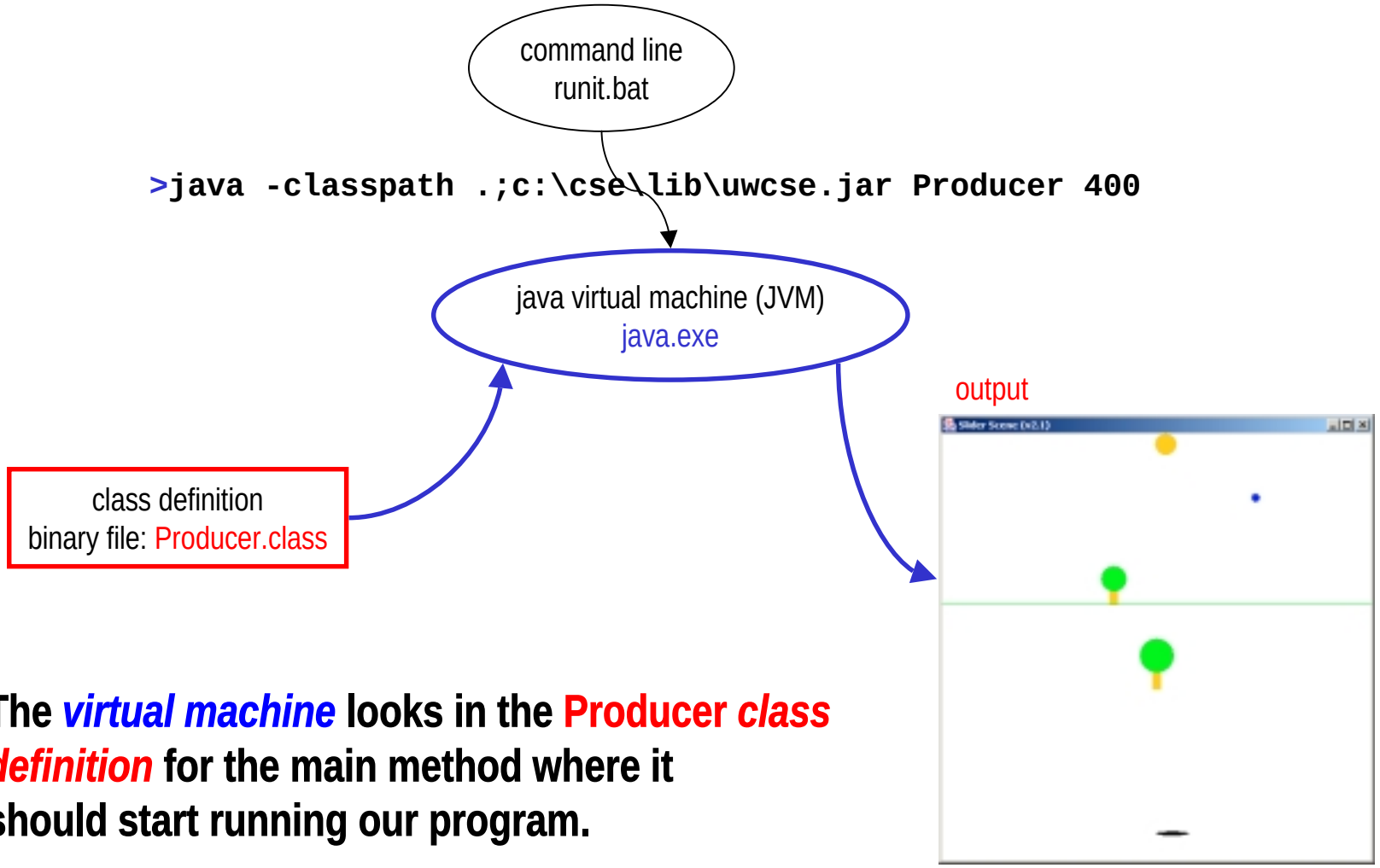
- Then we start the java virtual machine running and tell it the name of the class that contains the **`main`** method that we want to use

Launching a java program

- The **`java`** command launches a Java application. It does this by
  - » starting a Java runtime environment
  - » loading a specified class
  - » invoking that class' main method.
- The method declaration must look like the following:

```
public static void main(String args[])
```

Running a Java program



The *virtual machine* looks in the Producer *class definition* for the main method where it should start running our program.

Method main

- "static" is used to identify methods and variables that exist automatically *before any objects are created*
- main must always be defined like this

```
public static void main(String[ ] args) { … }
```

- Typical contents of main
  - create some objects and call some methods to get started
- args array contains any string arguments passed to the program when it was started.
  - Actual name need not be "args"

method **main** in **Namer**

```
public static void main(String[] arg) {
    if (arg != null && arg.length > 0) {
      System.out.println("The command line arguments are: ");
      for (int i=0; i<arg.length; i++) {
        System.out.println("arg "+i+": "+arg[i]);
      }
    }
    System.out.println();

    // create a list of names then print out a bunch of them
    // note that NameList deals with out of range subscripts for us

    NameList choices = new NameList(7);
    System.out.println("The first ten names");
    for (int i=0; i<10; i++) {
      System.out.print(choices.getName(i)+" ");
    }
    System.out.println();
}
```

from ex16

Static methods and fields

- Static members belong to the class, not to any instance of the class
  - » Both fields and methods can be static
  - » Java VM creates memory for static fields when the class is first loaded
- Static methods are often “utility” methods that don’t need an instance of the class
- Static fields are sometimes used as constants

drawing of classes and objects in memory

static methods

- Recall that methods implement behavior
  - » but some behaviors are not associated with a specific object for one reason or another
  - » static methods are often used as “utility” methods
- Static methods must be implemented in a class
  - » There are some “pure” utility classes like java.lang.Math and java.lang.System
  - » Other classes have some utility methods along with instance methods, like Integer.toString(int k)

java.lang.Math

```
static double abs(double a)
static double ceil(double a)
static double floor(double a)
static double rint(double a)
static long round(double a)
static int round(float a)

static double acos(double a)
static double asin(double a)
static double atan(double a)
static double atan2(double a, double b)
static double cos(double a)
static double sin(double a)
static double tan(double a)
static double toDegrees(double angrad)
static double toRadians(double angdeg)
```

```
static double exp(double a)
static double IEEEremainder(double f1, double f2)
static double log(double a)
static double pow(double a, double b)
static double random()
static double sqrt(double a)
static double max(double a, double b)
static double min(double a, double b)
```

```
double deg = Math.toDegrees(radians);
double distance = Math.sqrt(dx*dx + dy*dy);
```

java.lang.System static methods

```
static long currentTimeMillis()
```

Returns the current time in milliseconds.

```
static void exit(int status)
```

Terminates the currently running Java Virtual Machine.

```
static Properties getProperties()
static String getProperty(String key)
static String getProperty(String key, String def)
static void setProperties(Properties props)
static String setProperty(String key, String value)
```

Read and write the current system properties.

```
static void setErr(PrintStream err)
static void setIn(InputStream in)
static void setOut(PrintStream out)
```

Reassign the standard input, output, and error streams

System.exit(int status)

```
try {
   … attempt to initialize …
}
catch (NumberFormatException e) {
   System.out.println(usage);
   System.exit(1);
}
catch (IOException e) {
   System.out.println(e);
   System.exit(1);
}
```

More examples of static methods

`String Integer.toString(int i)`

- Returns a new String object representing the specified integer

`int Integer.parseInt(String s)`

- Parses the string argument as a signed decimal integer.

`void Collections.sort(List list)`

- Sorts the specified list into ascending order, according to the natural ordering of its elements.

`InetAddress InetAddress.getByName(String host)`

- Determines the IP address of a host, given the host's name.

Static Fields

- Recall that instance variables are created fresh for each instance of the class
  - » each instance has its own separate instance variable
- Static variables are only created once
  - » all references to a static variable point to exactly the same place in memory
- Static variables can be used to keep global values
  - » how many objects of some class have been created
  - » how many streams are open to another host machine

Static Field Example

- Only one copy of a static member exists for a class
  - » *static fields* are also called *static variables* or *class variables*

```
public class Employee {
   public Employee ( int salary ) {
      baseSalary = salary;
      numberOfInstances++;
   }
   static private int numberOfInstances = 0;
   private int baseSalary;
}
```

Constants: Static Final Fields

- Sometimes we just want to give a name to a constant value, like PI or E
- Solution: a static variable, but further qualified with *final* so it can't be changed after it is initialized.

```
public static final double PI = 3.14159265358979323846;
```

- Final variables must be initialized when declared
  - » cannot be changed later

Constants in the Java Libraries

- Class Math contains PI and E, with the expected values.

```
this.area = Math.PI * this.radius * this.radius;
```

- Classes like Integer and Double contain values like the largest possible int value, the error value NaN (not a number), etc

```
int biggest = Integer.MAX_VALUE;
double val = Double.NaN;
```

More useful constants

- The java.awt.Color class contains some preset color definitions

```
public final static Color WHITE = new Color(255,255,255);


Color bg = java.awt.Color.white;    // java 1.3
Color bg = java.awt.Color.WHITE;    // java 1.4
```

- The java.lang.System class contains some preset input / output streams

```
System.out.println("hi there");
```