METHODS (CONSTRCTORS/DESTRUCTORS), OPERATORS, CONTROL FLOW AND I/O

16TH LECTURE

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Outline

- **Methods**
  - Constructors & Destructor
  - Overloading
- **Control Flow**
  - If else, while, do while, for
- **I/O**
  - Java I/O System
  - InputStreams
  - FilterOutputStreams
  - Character I/O Streams
  - Modifying Stream Behavior
  - Sources & Sinks of Data
  - Modifying Stream Behavior

Constructor &Destructor

- Java guarantees proper initialization with constructors, helps cleanup with garbage collector

Guaranteed Initialization with the Constructor

```
class Rock {
        Rock() { // This is the constructor
        System.out.println("Creating Rock");
        }
}
public class SimpleConstructor {
    public static void main(String args[]) {
                for(int i = 0; i < 10; i++)
                        new Rock();
        }
}
```

Method Overloading

- One word, many meanings: *overloaded*

```
class Tree {
        int height;
        Tree() {
                System.out.println("Planting a seedling");
                height = 0;
        }
        Tree(int i) {
                System.out.println("Creating new Tree that is "
                + i + " feet tall");
                height = i;
                }
        void info() {
               System.out.println("Tree is " + height+ " feet tall");
        }
      void info(String s) {
                System.out.println(s + ": Tree is "+ height + " feet tall");
      }
}
```

Method Overloading

```
Import java.util.Random;
public class Overloading {
	public static void main(String[] args) {
	int i = 0;
	while(i != 9) {
		Tree t = new Tree(i = new Random().nextInt(10));
		t.info();
		t.info("overloaded method");
	}
	// Overloaded constructor:
	new Tree();
	}
}
```

Default Constructor: Takes no Arguments

- Compiler creates one for you if you write no constructors

```
class Bird {
        int i;
}
public class DefaultConstructor {
        public static void main(String[] args) {
                Bird nc = new Bird(); // Default!
        }
}
```

Constructor Initialization

- Order of initialization
  - Order that variables/objects are defined in class
- Static data initialization

```
class Cupboard {
        Bowl b3 = new Bowl(3);
        static Bowl b4 = new Bowl(4);
        // ...
```

b4 only created on *first* access or when first object of class **Cupboard** is created

this: Reference to Current Object

```
public class Leaf {
        int i = 0;
        Leaf increment() {
                i++;
                return this;
        }
        void print() {
                System.out.println("i = " + i);
        }
        public static void main(String[] args) {
                Leaf x = new Leaf();
                x.increment().increment().increment().print();
        }
}
```

this: Specifying a Member

- If you get lazy when creating identifiers
- Probably not a good practice, but I do it myself sometimes…

```
class Flower {
        String name;
        Flower(String name) {
                // Without "this" it would assign
                // the argument to itself:
                this.name = name;
        }
}
```

Destructor

- garbage collection
  - Garbage collection is not destruction
  - Your objects may not get garbage collected
  - Garbage collection is only about memory
- **finalize( )**
  - In theory: releasing memory that the GC wouldn't
  - It's never been reliable: promises to be called on system exit; (causes bug in Java file closing)
- You must perform cleanup
  - Must write specific cleanup method

Member Initialization

```
void f() {
        int i; // No initialization
        i++;
}
```

Produces compile-time error

- primitives are given default values if you don't specify values

```
class Data {
        int i = 999;
        long l; // Defaults to zero
        // ...
```

Explicit static Initialization

```
class Cup {
	Cup(int marker) {
		System.out.println("Cup(" + marker + ")");
	}
	void f(int marker) {
		System.out.println("f(" + marker + ")");
	}
}
class Cups {
	static Cup c1;
	static Cup c2;
	static {
		c1 = new Cup(1);
		c2 = new Cup(2);
	}
    Cups() { System.out.println("Cups()"); }
}
```

Array Initialization

```
int a1[]; // This...
int[] a1; // is the same as this!
```

- Creates a reference, not the array. Can't size it. To create an array of primitives:

```
int[] a1 = { 1, 2, 3, 4, 5 };
```

- An array of class objects:

```
Integer[] a = new Integer[20];
System.out.println("length of a = " + a.length);
for(int i = 0; i < a.length; i++) {
        a[i] = new Integer(i);
        System.out.println("a[" + i + "] = " + a[i]);
}
```

length produces size

Array Initialization

- Can also use bracketed list (The size is then fixed at compile-time)

```
Integer[] a = {
        new Integer(1),
        new Integer(2),
        new Integer(3),
};
```

- If you do anything wrong either the compiler will catch it or an exception will be thrown

Control Flow

- the keywords
  - **if-else**, **while**, **do-while**, **for**, and a selection statement called **switch**.
- Java does not support the much-maligned **goto** (which can still be the most expedient way to solve certain types of problems).
- You can still do a goto-like jump, but it is much more constrained than a typical **goto**.

Control Flow

- **If else**
  - The conditional must produce a **boolean** result.
  - **Form**

```
if(Boolean-expression)
        Statement
         or
if(Boolean-expression)
        statement
 else
        statement
```

Control Flow Cont'd

- **Iteration**
  - **while**, **do-while** and **for** control looping and are sometimes classified as *iteration statements*. A *statement* repeats until the controlling *Boolean-expression* evaluates to false.

  - The form for a **while** loop

```
while(Boolean-expression)
        Statement
```

  - The form for do-while is

```
do
  statement
while(Boolean-expression);
```

Control Flow Cont'd

- **Iteration cont'd**
  - The form of the for loop is:

for(initialization; Boolean-expression; step)

statement

```
public class WhileTest {
  public static void main(String[] args) {
    double r = 0;
    while(r < 0.99d) {
      r = Math.random();
      System.out.println(r);
    }
  }
} ///:~
```

The Java I/O System

- Goal
  - to provide abstractions of all aspects of I/O
    - Directory structure, File, Memory, Network, etc.
- Expressing all possible configurations
  - Character, binary, buffered, reading lines, transparent data transfer, etc.

The File class

- Deceiving
  - refers to one or more file *names*, not a handle to a file itself
    - *Composite* design pattern: to represent tree structured hierarchy (node and leaf)
- Set of file names
  - **list( )** gives an array of **String**
- For a subset of file names, you hand **list( )** an object that **implements FilenameFilter**

Example: Limiting the Number of Files Returned by the list() Method

- Use of String[] list(FileNameFilter FFObj);
  - *FFObj* is an object of a class that implements the **FileNameFilter** interface
    - Defining only a single method,

      boolean accept(File directory, String filename);
      - Returning true for files in the directory that should be included in the list
- OnlyExt class implementing **FileNameFilter**
  - Restricting the visibility of the filenames returned by **list**() to files with names that end in the file extension specified when the object is constructed

Example: Limiting the Number of Files Returned by the list() Method Cont'd

- OnlyExt class

```
import java.io.*;
public class OnlyExt implements FilenameFilter {
    String ext;
    public OnlyExt(String ext) {
        this.ext = "." + ext;
    }
    public boolean accept(File dir, String name) {
        return name.endsWith(ext);
    }
}
```

Example: Limiting the Number of Files Returned by the list() Method Cont'd

- Displaying files that use the .html extension

```
// Directory of .HTML files.
import java.io.*;
class DirListOnly {
    public static void main(String args[]) {
        String dirname = "/java";
        File f1 = new File(dirname);
        FilenameFilter only = new OnlyExt("html");
        String s[] = f1.list(only);
        for (int i=0; i < s.length; i++) {
            System.out.println(s[i]);
        }
    }
}
```

I/O Fundamentals

- Different kinds of I/O
  - Files, the console, blocks of memory, network connections
- Different kinds of operations
  - Sequential, random-access, binary, character, by lines, by words, etc.

Binary Input and Output

- **InputStream**
  - All have **read( )** methods you won't usually use
  - Sometimes tricky to tell when you're at the end
- **OutputStream**
  - All have **write( )** methods you won't usually use
- Wrapping classes in "decorators" to add functionality. More work while coding.

Adding Attributes & Useful Interfaces

- Two issues with I/O streams:
  - What you're talking to
  - The *way* you talk to it
- One approach
  - Making a class for every possible combination
- Alternative
  - Java's "filter" streams (decorators)
- Dynamically creating the functionality you need
  - Input: **FilterInputStream**
  - Output: **FilterOutputStream**

Filter Input Streams

- **DataInputStream**
  - Full interface for reading primitive and builtin types
- **BufferedInputStream**
  - Adding buffering to the stream (usually do this)
- **LineNumberInputStream**
  - Adding line numbering functionality (nothing else; you'll probably add another filter)
- **PushbackInputStream**
  - Implementing a one-character push back, for scanners. You probably won't use this

Filter Output Streams

- **DataOutputStream**
  - Full interface for writing primitive and built-in types; complementing **DataInputStream** for portable reading & writing of data
- **PrintStream**
  - Allowing primitive formatting for data display
- **BufferedOutputStream**
  - Adding a buffer to the output stream (usually do this)

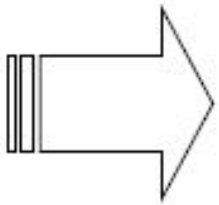
Character I/O Streams

- Added in Java 1.1
- Can appear that they are intended to replace **InputStream** and **OutputStream**
- **Reader** and **Writer** classes
  - Internationalization: uses 16-bit **char** (capable of holding Unicodes) instead of 8-bit **byte**
  - Also designed to improve speed
- Classes with no Character Versions
  - DataOutputStream
  - File
  - RandomAccessFile
  - SequenceInputStream

Sources & Sinks of Data

Binary

- **InputStream**
- **OutputStream**
- **FileInputStream**
- **FileOutputStream**
- **StringBufferInputStream**
- (no corresponding class)
- **ByteArrayInputStream**
- **ByteArrayOutputStream**
- **PipedInputStream**
- **PipedOutputStream**

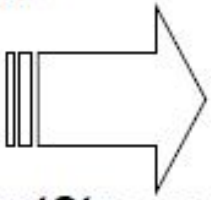


Character

- **Reader**
  converter: **InputStreamReader**
- **Writer**
  converter: **OutputStreamWriter**
- **FileReader**
- **FileWriter**
- **StringReader**
- **StringWriter**
- **CharArrayReader**
- **CharArrayWriter**
- **PipedReader**
- **PipedWriter**

Modifying Stream Behavior

Binary	Character
• **FilterInputStream**	• **FilterReader**
• **FilterOutputStream**	• **FilterWriter** (abstract class with no subclasses)
• **BufferedInputStream**	• **BufferedReader** (also has **readLine( )**)
• **BufferedOutputStream**	• **BufferedWriter**
• **DataInputStream**	• Use **DataInputStream** (except when you must use **readLine( )**, then use a **BufferedReader**)
• **PrintStream**	• **PrintWriter**
• **LineNumberInputStream**	• **LineNumberReader**
• **StreamTokenizer**	• **StreamTokenizer** (Use constructor that takes a **Reader** instead)
• **PushBackInputStream**	• **PushBackReader**



File I/O Examples

- **FileInputStream**
  - Getting bytes from a file

```
import java.io.*;
public class Read {
  public static void main(String[] args) {
    try {
      FileInputStream f = new FileInputStream("in.txt");
      int b;
      while ((b = f.read()) != -1)
        System.out.print((char) b);
    } catch (FileNotFoundException fnfe) {
      // System.out.println(fnfe);
      fnfe.printStackTrace();
    } catch (IOException ioe) {
      ioe.printStackTrace();
    }
    System.out.flush();
  }
}
```

File I/O Examples (Cont'd)

- **FileOutputStream**
  - Writing bytes to a file

```
import java.io.*;
public class Write {
  public static void main(String[] args) {
    try {
      byte ova[] = {'o', 'u', 't', '\n'};
      FileOutputStream f = new FileOutputStream(args[0]);
      f.write(ova);
      f.close();
    } catch (IOException ioe) {
      ioe.printStackTrace();
    }
  }
}
```