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
• Java guarantees proper initialization with constructors, helps cleanup with garbage collector
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();
    }
}

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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");
    }
}

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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

```java
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

```java
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
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…

```java
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

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

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

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

Produces compile-time error
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

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

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

- An array of class objects:

```java
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]);
}
```
Array Initialization

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

```java
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);
    ```
Iteration cont’d

– The form of the for loop is:

\[
\text{for}\text{(initialization; Boolean-expression; step)}\text{statement}
\]

```java
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

```java
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

```java
// 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
- FilterInputStream
- FilterOutputStream
- BufferedInputStream
- BufferedOutputStream
- DataInputStream
- PrintStream
- LineNumberInputStream
- StreamTokenizer
- PushBackInputStream

### Character
- FilterReader
- FilterWriter (abstract class with no subclasses)
- BufferedReader (also has `readLine` function)
- BufferedWriter
- Use `DataInputStream` (except when you must use `readLine` function, then use a `BufferedReader`)
- PrintWriter
- LineNumberReader
-StreamTokenizer
  (Use constructor that takes a Reader instead)
- PushBackReader

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File I/O Examples

- FileInputStream
  - Getting bytes from a file

```java
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

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