CS 335
Graphics, Image Processing, User Interface Design

2-3:15 TR 207 RGAN

Brent Seales

Course Goals

- Programming with ***Java*** and associated APIs
- Graphical User Interfaces (GUIs)
- Introduction to Image Processing
- Introduction to 2D Computer Graphics

Administrative Issues

- Course Webpage – check early and OFTEN

http://dmn.netlab.uky.edu/~seales/cs335.html

- Mailing List
- Course Work
  - 5 Programming assignments
  - 4 Exercises (Problem Sets)
  - 2 Exams
- Assistant

  TBA

Introduction to Java

The Java Programming Language: Selected Web Resources

Java Homepage: `www.java.sun.com`

Java JDK 6 Update 2 `java.sun.com/javase`

Java Advanced Imaging (JAI):

`jai.dev.java.net`

The Java Tutorials:

`java.sun.com/docs/books/tutorial/`

On-line trade magazines, etc:

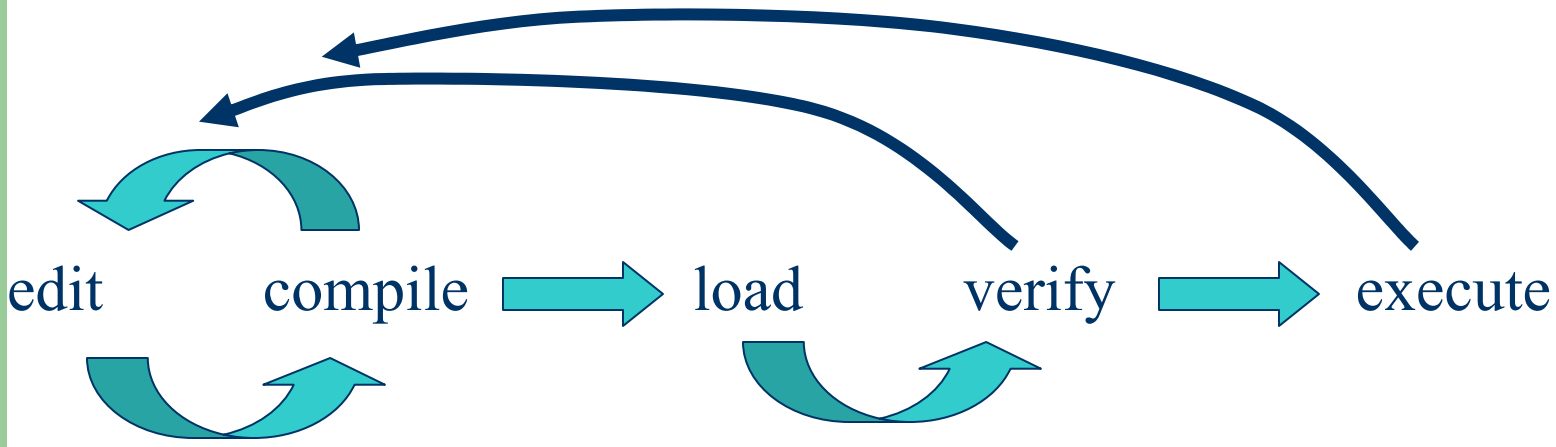
`www.javaside.com/`

`www.javaworld.com/`

Additional Materials

- The Java Advanced Imaging (JAI) libraries
- The Java 3D environment
- Java tutorial materials
- Java API documentation

Program Development Cycle



What does this mean for Java, which is an *interpreted* language?

Java is Interpreted

Source Code

Java source is text saved in a file with a .java extension. Java looks like C++.

Compile source using Java compiler

```
javac Myprogram.java
```

Compiler produces an output file, which ordinarily would be executable code (machine instructions).

Low-level "bytecode" file

```
Myprogram.class
```

Executing Java Programs

Standalone java program:

invoke the Java interpreter:

`java Myprogram` (no extension; assumes .class)

Loader finds **`Myprogram.class`**, loads it into local memory, verifies it, and interprets (executes) it.

(run examples)

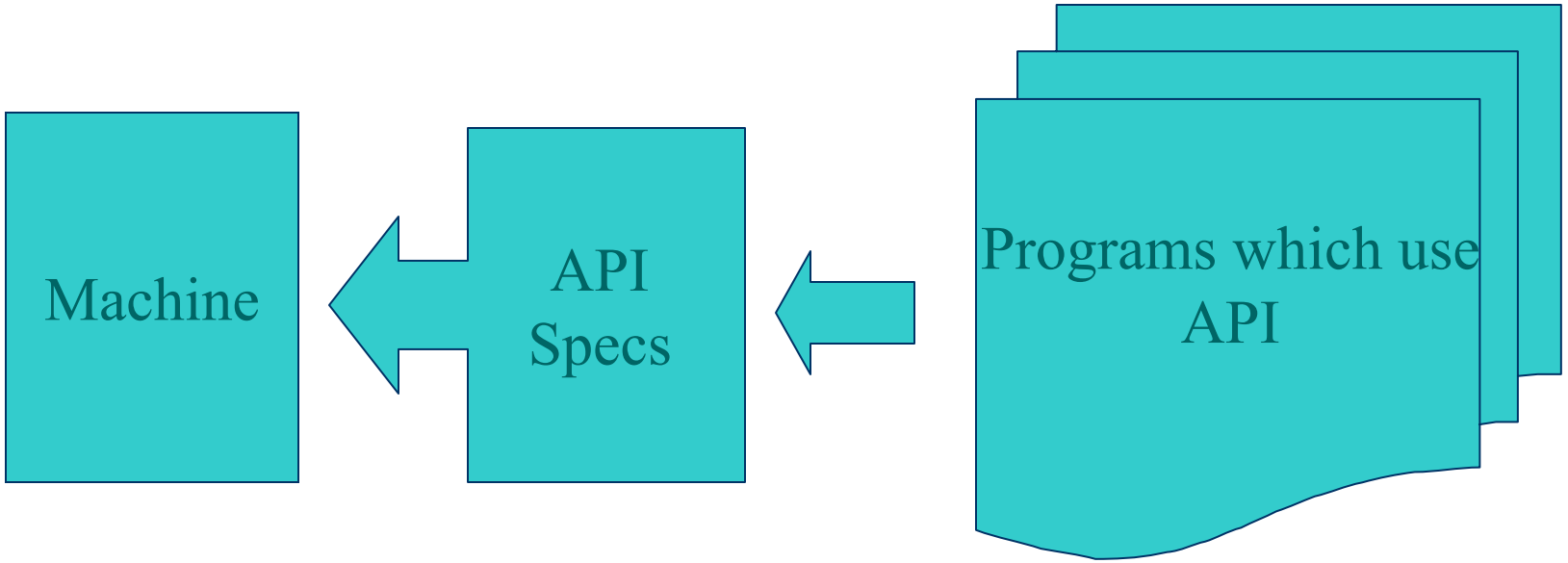
Example: A Complete Java Program

```
import java.io.*;

public class Testclass
{
  public static void main( String args[] ) throws
IOException
  {
    int count = 0;

    while ( count < 10 )
    {
      System.out.println("counter is " + count );
      count++;
    }
  }
}
```

New concepts with Java?



Interpreter/Emulator/API

Interpreter/emulator is an old idea:

- WINE: Windows interpreter for Linux OS
- SoftWindows: Windows interpreter for Silicon Graphics
- Executor: Macintosh emulator for Wintel PCs

Application Programmer Interface (API) is an old idea

- OpenGL: Graphics language
- Renderman
- etc.

New Possibilities

Combine API and Interpreter: network transparency via HTML

- Each hardware platform has specific implementation of API for local hardware
- Each platform can run interpreter
- Interpreter gives security from programs coming over network
- Applications can run anywhere

The Robust Java API

- The interface contains classes which can be declared directly or extended which do complex tasks:
  - Manage buttons
  - Manage text input windows
  - Display images
  - Read audio files
  - Run multiple threads in parallel

- Short Java programs can accomplish complex tasks via the API.

Interpreted Java: What about speed?

- API classes can perform well when implemented locally
- Most applets end up being a series of API calls
- Computers are faster
- Network is still the bottleneck for many applications

Why is Java the best?

- It isn't, necessarily!
- Includes powerful ideas
- First to get API + secure interpreted "platform independence” to be widely accepted

Summary

Java Development Environment:
edit, compile, load, verify, execute

Applets are different from standalone Java programs

Java combines powerful API (via complex classes) with interpreter and network (HTTP) interfaces.

Programming in Java

- Define data
- Calculate using data
- Output result

Java is object-oriented:

- Merge data and functions into object
- Invoke functions to operate on data

Java program must:

- Define data and functions (in a class)
- Invoke functions to compute things

Object-Oriented Programming: Classes

A class is an object definition, and includes data and functions on that data:

```
public class MyCourseGrade
   {
      int pset1;
      int pset2;
         :
      int final_exam;

   computeAverage()
      {
         :
      }
}
```

object data

object method

Classes

Class: code which defines an object

Object: a variable (data + methods) which is an instance of a class

Java program: a bunch of class definitions, variables, etc.

Classes

One special class (the "mother of all classes") contains main(), and this is where flow of control begins:

class Test

main

Kernel of execution is here!

class AnotherClass (like MyCourseGrade)

memberFunc1()

memberFunc2()

Notes

- Java flow of control starts in **main()**, in whichever class **main()** is defined
- There can only be one class per file (unless you are defining subclasses)
- The filename must match the class name in a Java source file!

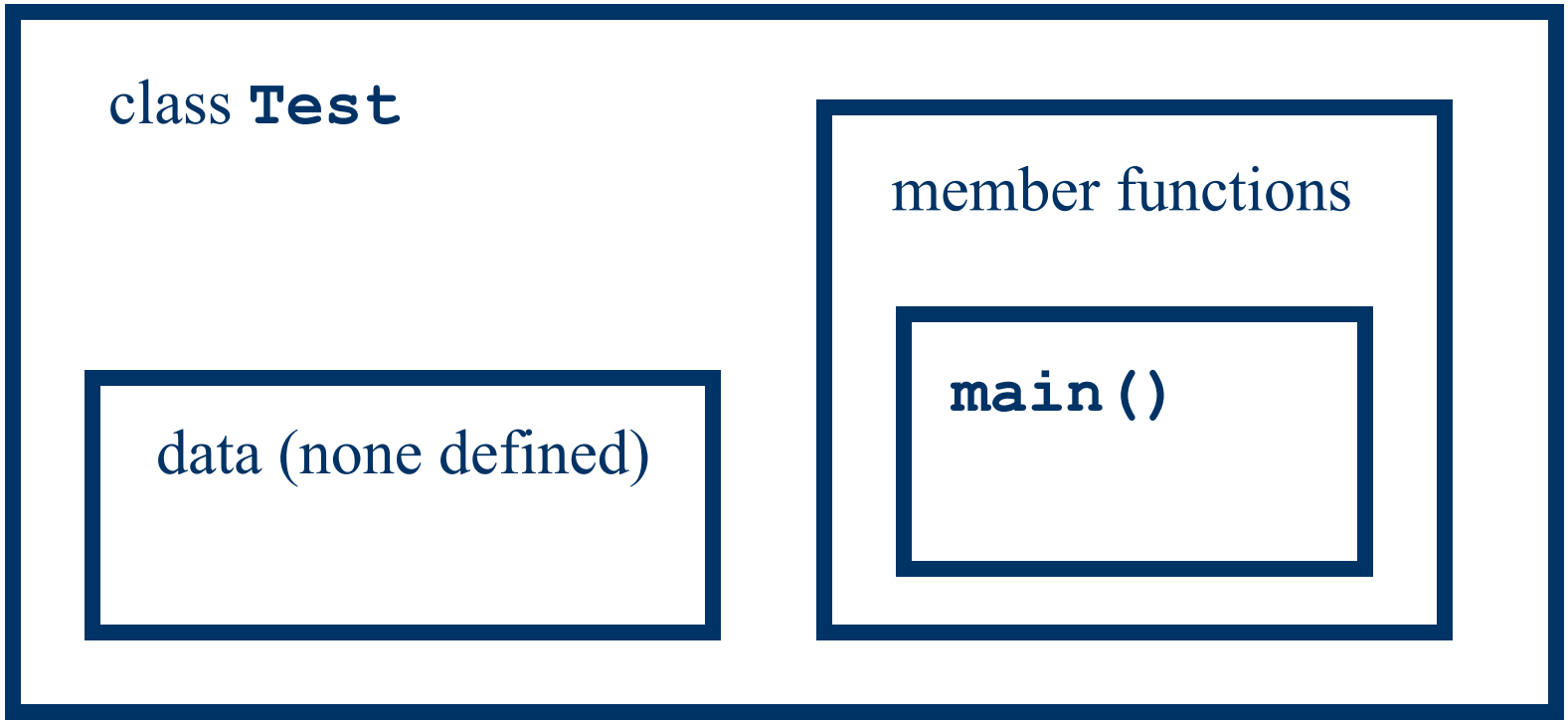
Example 1

A Java program with one class and one member called **`main()`**:

```
import java.io.*;

public class Test
{
  public static void main( String[] str )
         throws IOException
  {
    System.out.println("That's it, folks!");
  }
}
```

Example 1: Scoping

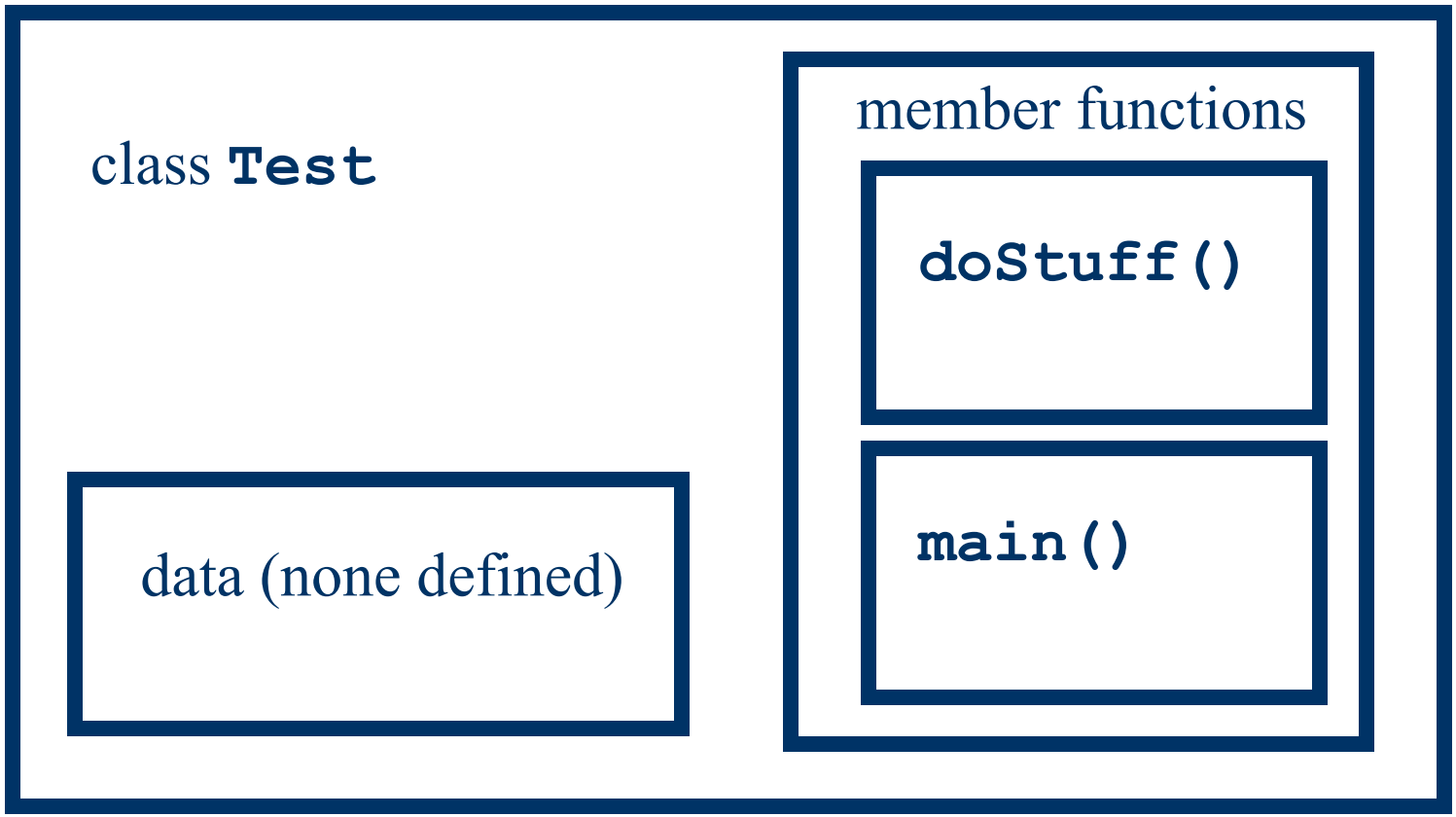


Example 2

Add another member function:

```
import java.io.*;
public class Test
{
  public static void main( String[] str )
              throws IOException
  {
    System.out.println("That it, folks!");
  }
   public void doStuff()
  {
    System.out.println("doing stuff." );
  }
}
```

Example 2: Scoping



Example 3

Define an object of class Test and make a function call

```
import java.io.*;
public class Test
{
  public static void main( String[] str )
              throws IOException
  {
    Test t;  // t  is of type "Test"
    t = new Test();  // allocate object
    t.doStuff();  // call member function
    System.out.println( "That it, folks!");
  }
```

Example 3 (continued)

```
public void doStuff()
   {
     System.out.println( "I'm doing stuff." );
   }
}
```

Notes:

- Static methods cannot access nonstatic class members directly
- **`main()`** must always be static

Example 4

Test.java:

```
import java.io.*;
public class Test
{
  public static void main( String[] str )
throws IOException
  {
    Stuff t;
    t = new Stuff();
    t.doStuff();
    System.out.println( "That it, folks!" );
  }
}
```

Put main class and a different class in separate files:

Example 4

Stuff.java:

```
public class Stuff
{
  public void doStuff()
  {
    System.out.println( "I'm doing stuff." );
  }
}
```

Notes

- One class per file
- To compile: **`javac Test.java`**

Java I/O

The `System` object provides a way to manage I/O from a more traditional "stream" (terminal window).

GUI-based I/O requires the **`action()`** method to deal with GUI mouse events.

The System object requires no **`action()`** method

But terminal I/O is inadequate in a browser-based (GUI) environment.

Summary of Some Basic Java Constructs

Everything is related to objects:

Data declaration:

```
int i;    // declare i to be an int
Test t;   // declare t to be
          // an object of type Test
i = 0;    // set the int i equal to 0
t = new Test();
      // initialize t and allocate space
      // using a constructor
```

Java Constructs

Flow of Control:

Traditional, but with object-oriented syntax for function calls and member functions

Where control starts in the Applet class is important

Executable statements

Similar to C/C++: **`while`**, **`for`**, **`if/else`**, **`switch`**, etc.