

# **COMP 1210**

## **Fundamentals of Computing I**

Fall 2011

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<http://www.eng.auburn.edu/~cross/comp1210>

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## **Course Overview**

0. Syllabus (<http://www.eng.auburn.edu/~cross/comp1210/>)
  1. Introduction
  2. Data and Expressions
  3. Using Classes and Objects
  4. Writing Classes
  5. Conditionals and Loops
  6. More on Conditional and Loops
  7. Object-Oriented Design
  8. Arrays
  9. Inheritance
  10. Polymorphism
  11. Exceptions
- (Lecture Notes 2 through 10 are in separate files.)

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# 1. Introduction

- Objectives - when we have completed this introduction to computing, you should be able to:
  - Understand the basics of software and its relationship to hardware
  - Write simple Java programs
  - Edit, compile, and run Java programs using jGRASP
  - Set a breakpoint and step through your program in debug mode
  - Use Javadoc comments in your programs
  - Run Checkstyle to verify your comments and format
  - Generate documentation for your programs

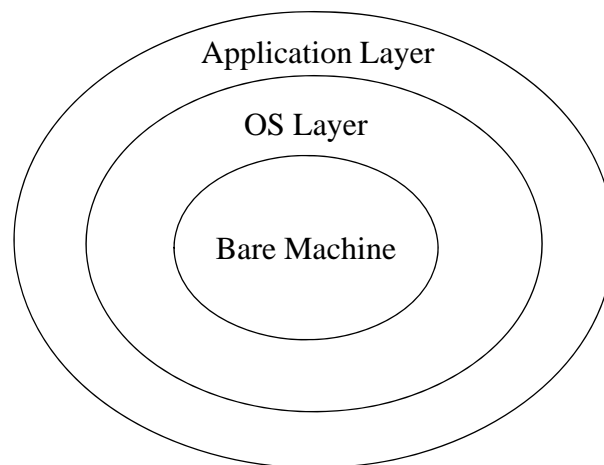
## Background

- Computer System
  - Hardware and Software
- Hardware
  - "Physical" processor, memory, I/O devices, ...
- Software
  - "Abstract" instructions and data stored electronically
  - Human readable as text
  - Machine readable as executable binary
- Computing
  - "The Act of" - Software running (executing) on hardware, processing input and producing output to solve a problem, entertain, communicate, etc.
- Fields/Disciplines of Computing
  - CS + SwE (incl WRSwE) + CpE + IS + IT + ...

## Sw and Hw Relationship

- Bare Machine
  - All physical components, devices, microcode
- OS/Network Layer
  - All system software: OS, Network, device drivers (Windows, Linux, Mac OS X, UNIX)
  - Management of all hardware: processor, memory, I/O devices
  - Management of all running software (multiple processes)
- Application Layer
  - All software applications: MS Office, Internet browsers, IDEs (Integrated Development Environments), compilers, ..., embedded systems

## Sw and Hw Relationship



# Software

- In COMP 1210
  - Hw is assumed; designed/implemented by CpE, EE, physicists, etc.
  - Sw is our focus; designed/implemented by CS, SwE, IS, etc.
- Developing Sw is about
  - Problem solving
  - Design, implementation, testing, ...
  - Managing the inherent complexity
  - Organizing the algorithms (directions) and data as classes and objects (object-oriented programming)

# Object-Oriented Concepts

- Classes
- Objects
- Encapsulation
- Inheritance
- Polymorphism
- graphical user interfaces
- the Java programming language

# Java

- A *programming language* specifies the words and symbols that we can use to write a program
  - employs a set of rules (*syntax*) that dictate how the words and symbols can be put together to form valid *program statements*
  - Defines the meaning (semantics) of *program statements*
- Java was created by Sun Microsystems and introduced in 1995 (acquired by Oracle, 2010)
- Java continues to evolve and grow in importance to the software industry

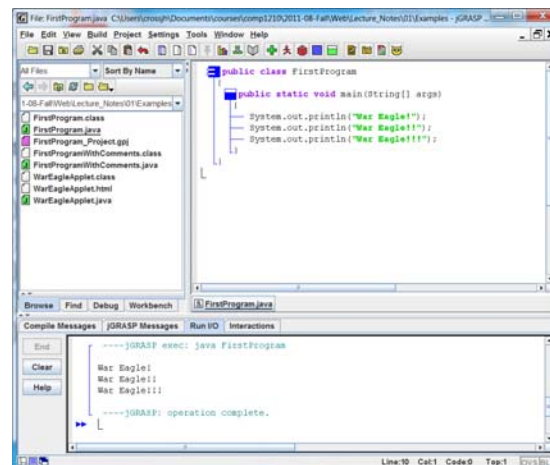
## Java Program Structure

- In the Java programming language:
  - A ***program*** is made up of one or more *classes*
  - A ***class*** contains data and/or *methods*
  - A ***method*** contains local data and program *statements* that form an *algorithm*
- These terms will be explored in detail throughout the course
- A Java application has a class containing a method called **main**

# First Program with jGRASP

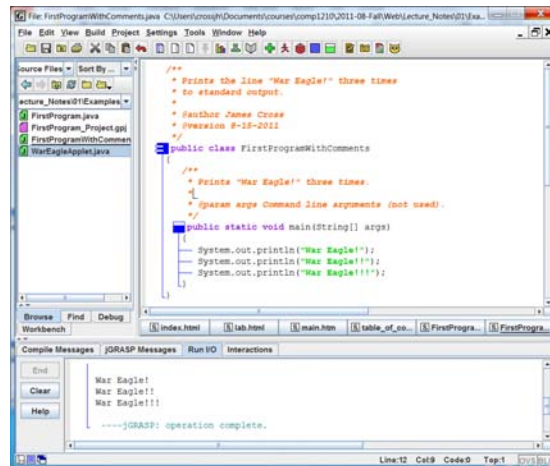
1. Start up jGRASP
2. Open a new file
3. Enter the program (incrementally)
  - The program should print "War Eagle"
4. Save program
5. Compile program
6. Run program (check for correct output)
7. Set a breakpoint and Debug (step through each statement)
8. Generate CSD, Line No., and Documentation

## jGRASP



[FirstProgram.java](#)

# jGRASP



[FirstProgramWithComments.java](#)

## Software Concepts

Algorithms and Data  
Dissecting a Java Program  
Program Development, Translation, and Execution  
Syntax, Semantics, and Errors  
Overview of Programming Languages  
Object-Oriented Programming  
Applets vs. Applications

# Algorithms and Data

- Sw ::= algorithms ("instructions") and data
- Algorithms ::= Sequence, Selection, Iteration of instructions
- Pseudo-code (initial prog. design) becomes "formal" program (i.e., code in a programming language like Java)
  - Pseudo-code can become comments in the program
- Many pieces of code for algorithms and data
- Organized into classes which define objects (Object-Oriented Programming)

# Dissecting a Java Program

```
/**
 * Prints the line "War Eagle!" three times
 * to standard output.
 *
 * @author James Cross
 * @version 8-15-2011
 */
public class FirstProgram
{
    /**
     * Prints "War Eagle!" three times.
     *
     * @param args Command line arguments (not used).
     */
    public static void main(String[] args)
    {
        System.out.println("War Eagle!");
        System.out.println("War Eagle!!");
        System.out.println("War Eagle!!!");
    }
}
```



## Parts of this Program

- Comments
- Class
- **main** Method
- Identifiers
  - Reserved Words
  - Variable names (Ch 2)
- Java API
- Literals
- White space

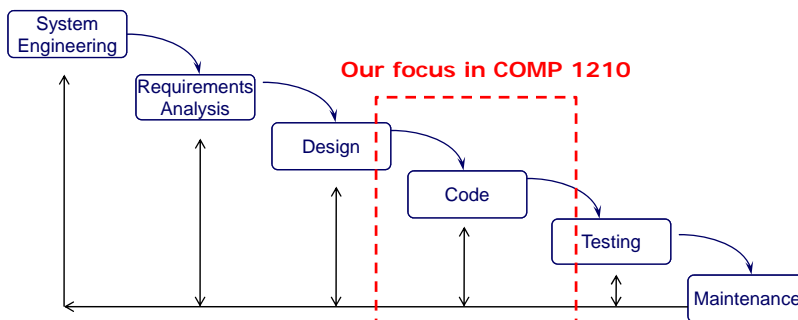
**Identifiers** can be any combination of letters, digits, dollar sign (\$) and underscore (\_) characters; cannot begin with a digit. Java is “case sensitive”.

```
/**
 * Prints the line "War Eagle!" three times
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 *
 * @author James Cross
 * @version 8-15-2011
 */
public class FirstProgram
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     * Prints "War Eagle!" three times.
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    public static void main(String[] args)
    {
        System.out.println("War Eagle!");
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    }
}
```



## Program Development

- There's more to developing software than coding (a.k.a. implementation)!



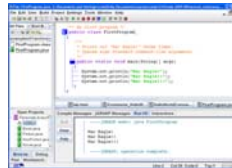
- Many variants of the process model

## Program Development (cont.)

- Code
  - Writing source code that will be compiled into a program.
  - **Coding standard:** Rules as to how source code should be formatted - makes code easier to read and debug.
- Test
  - Once you write your program, make sure that the **actual output** of your program (your programs output) matches the **expected output** (the correct output as specified by the customer).

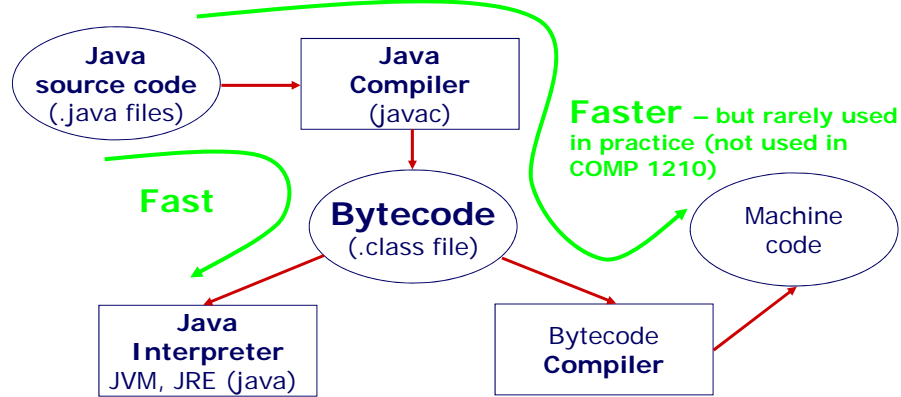
## Program Development (cont.)

- Program development tools are valuable aids during the process.
  - A good IDE (integrated development environment) with program editor, debugger, interactions, etc. will should become one of your best sw tools.
  - *jGRASP* ([jgrasp.org](http://jgrasp.org)) with Java, Checkstyle, JUnit, Web-CAT
  - *Checkstyle* is used with jGRASP to support the COMP 1210 coding standard.

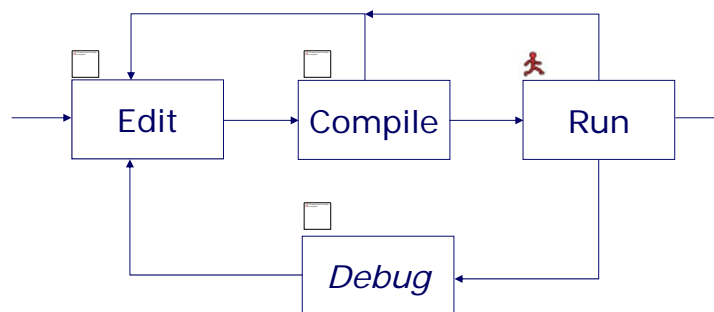


## Program Translation

- **Compiler v. Interpreter (Java Virtual Machine)**
- The Java translation process:



## The Implementation Cycle...



- This cycle implies incremental program construction.
- Plan to repeat this cycle early and often.

## Syntax and Semantics

- Syntax: 'grammar'
  - Rules of how the vocabulary can be used to compose legal structures in the language.
  - In the context of programs, the language syntax describes how to create legal statements and other constructs in the language.
- Semantics: meaning
  - What a given legal structure in the language means.
  - In the context of programs, the language semantics describes what will happen when a legal statement in the language is executed.

## Syntax and Semantics (cont.)

- In natural languages, some things can be syntactically correct but have no meaning...
  - Blue ideas sleep furiously.
- ... or be syntactically correct but have many (possible) meanings.
  - Time flies like an arrow.
  - The house flies like a saucer.
  - Did you ever see a home run?
- Programming languages do not allow these situations - - there is no ambiguity!
  - A program will have the same behavior each time it is run - - assuming input, if any, is the same.



## Program Errors



- **Compile-time errors**
  - Compilation cannot be completed
    - Syntax errors
    - Static semantic errors
  - The Java compiler will not produce bytecode.
- **Logical errors (logic errors)**
  - Execution proceeds and halts normally, but incorrect behavior or incorrect results are observed.
- **Run-time errors**
  - Execution is halted abnormally.
    - Deep-end, crash, blow up, crash and burn, hosed
  - Illegal operations, exceptions.
- Find errors by **testing** and remove them by **debugging**

## Overview of Programming Languages

- A programming language is an artificial language designed for humans to express programs and have that program translated into machine-executable form.
- Programming languages can be categorized in different ways, for example:
  - Machine languages
  - Assembly languages
  - **High-level languages**
- Languages in different categories are obviously going to be very different from each other, but even languages within the same category can vary widely.

## Same Program, Different Languages

### Java

```
/** Prints a quote from the Plains */
public class War_Eagle
{
    public static void main(String[] args)
    {
        System.out.println ("War Eagle!\n");
    }
}
```

### C

```
/* Prints a quote from the Plains */
main()
{
    printf ("War Eagle!\n");
}
```

### Ada

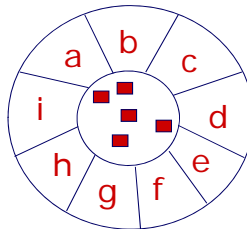
```
-- Prints a quote from the Plains
with Ada.Text_IO;
use  Ada.Text_IO;
procedure War_Eagle is
begin
    Put ("War Eagle!");
    New_Line;
end War_Eagle;
```

### Perl

```
# Prints a quote from the Plains
print "War Eagle!", "\n";
```

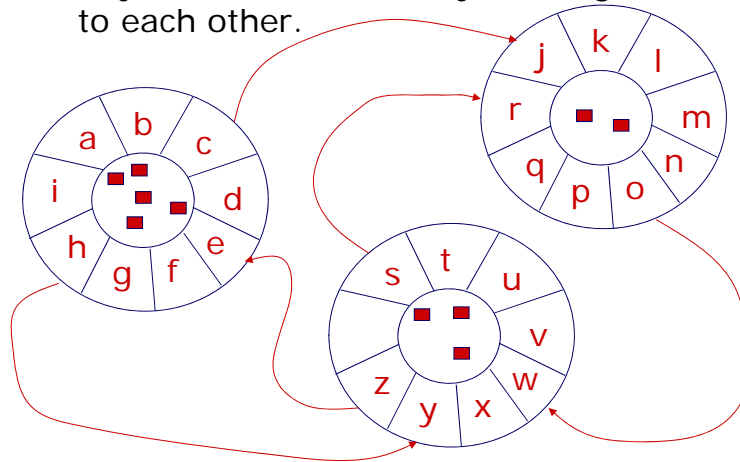
## Object-Oriented Programming

- OOP is a programming world-view in which things in the real world are modeled as software **objects**.
  - An object is really just an **abstraction** of a real-world thing, implemented as an **encapsulation** of private **data** and **methods** (operations on that data).



## Object-Oriented Programming (cont.)

- Objects communicate by sending **messages** to each other.



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## Object-Oriented Programming (cont.)

- **Class** = a description of an entire category or group of objects
  - Classes model categories of real world things by describing their “data” and their “operations.”

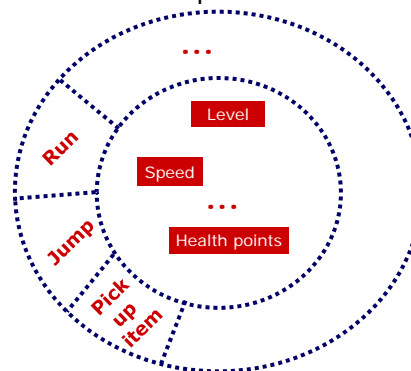
Class Name: GameCharacter

Data:

Level  
Speed  
Health points  
...

Operations:

Run  
Jump  
Pick up item  
...

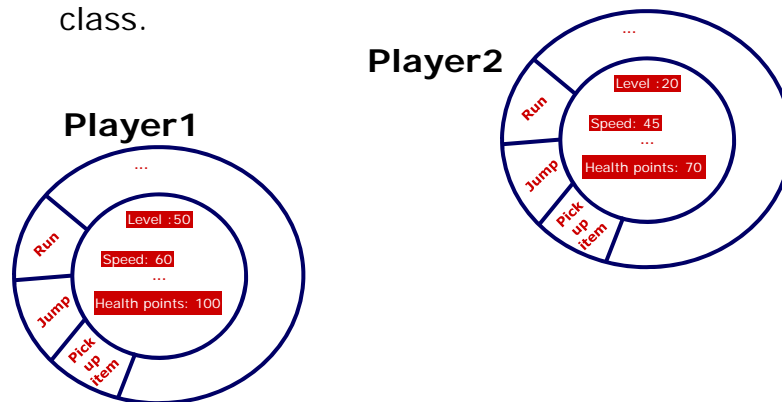


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## Object-Oriented Programming (cont.)

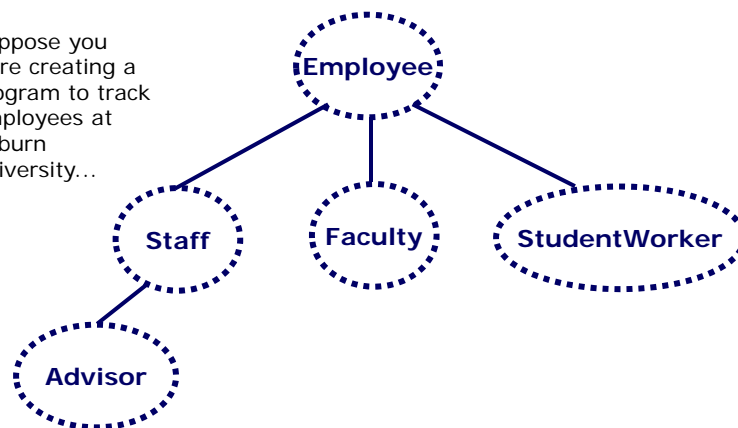
- An object is an **instance** of some particular class.



## Object-Oriented Programming (cont.)

- New classes are derived from existing ones through **inheritance**.

Suppose you were creating a program to track employees at Auburn University...





## Object-Oriented Programming (cont.)

- OOP is intended to support software **reuse**.
- **Class libraries** are an important element of this support.
  - Class libraries are sets of classes designed to be reusable components whose services can be used by many programs.
- The Java Application Programming Interface (**API**) is a set of class libraries that comes with the **JDK**.
  - The Java API is organized into **packages** such as `java.awt`, `java.io`, `java.lang`, and `java.net`
  - Example: The `System` class that you use in your output statements is in the `java.lang` package

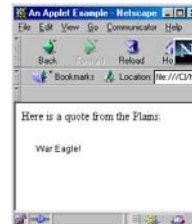
## Applications v. Applets

- Java programs can be executed in a “stand alone” fashion just like programs in other languages.
- Such a Java program is called an **application**.
- One of the distinguishing features of Java is that its bytecode can be embedded in an HTML document, transported across a network, and executed within a web browser.
- Such a Java program is called an **applet**.

## Applet Example

```
import java.awt.*;
import java.applet.*;
public class WarEagleApplet extends Applet
{
    public void paint (Graphics page)
    {
        page.drawString("War Eagle!", 20, 20);
    }
}
```

```
<html>
<head>
<title>An Applet Example</title>
</head>
<body>
<p>
Here is a quote from the Plains:
</p>
<applet code="WarEagleApplet.class">
</applet>
</body>
</html>
```



[Show Applet!](#)

[WarEagleApplet.java](#)