What is a computer program?

- A sequence of instructions used to carry out a particular task
- Programs exist for a huge variety of tasks
  - Word processing
  - Games
  - Music/video
  - Browsing the Internet
  - Programming tools
  - Viruses

Computer organization:

- Central Processing Unit (CPU): executes instructions (e.g. arithmetic, send/retrieve data to/from memory and other devices)
- Storage:
  - Primary – Random Access Memory (RAM): fast access (nanoseconds), expensive, loses data when powered off
  - Secondary – Hard disk: much slower (milliseconds) but cheaper, data persists when powered off
- Peripherals:
  - Input devices: keyboard, mouse, iPod’s clickwheel
  - Output devices: monitor, printer, etc.

Machine code

- Each type of CPU (Pentium, SPARC, PowerPC, etc) has a specific set of instructions it can execute
- Code that corresponds to these instructions is called *machine code* – this is the only language the processor “speaks”
- Machine code is extremely difficult for humans to directly write and maintain

Human-readable code

- Instead, we use *higher-level* programming languages, which let us think more abstractly
- High-level code is easier to understand, organize, and write
- A single statement in a high-level language may represent several machine instructions
High-level code to machine code

• Compiled languages (e.g. C, C++, Fortran, Pascal, etc.) use a program called a compiler to generate machine code from high-level code
• Need a separate compiler for each type of CPU

Java

• Developed at Sun Microsystems; first release in 1995, current version is 6.0
• Some goals of Java:
  – Object oriented
  – Architecture independent (“write once, run anywhere”)
  – Secure – designed with Internet in mind
  – Simple to use

Java Virtual Machine

• Java source code (.java files) is compiled to an intermediate representation called Java bytecode (.class files), not directly to machine code
• A separate program called the Java Virtual Machine (JVM) then executes the bytecode by translating it to machine code
• Result: a Java program is compiled only once and then can be run on a JVM on any platform

Example Java Program

```java
public class Hello {
    public static void main(String[] args)
    {
        // Prints a greeting
        System.out.println("Hello, World!");
    }
}
```

Java Programs

• All code is inside one or more classes
  – Understanding classes is a huge component of this course
  – For now, think of a class as a container of code
• Within a class, instructions are grouped into blocks called methods
  – In Hello example, main is the only method in the Hello class
  – Typical programs have many methods

Java Programs

• This is an example of a Java statement:
  System.out.println(“Hello, World!”);
• println is a method of the System.out class
• It prints the phrase Hello, World! on the console and starts a new line of text
• We can change the text that is printed by changing the text inside the quotes
Java syntax

- Syntax: set of rules to which a program must conform to be valid
- Case-sensitive: `main` is not same as `MAIN`
- Statements end with a semi-colon `;`
- White-space (spaces, tabs, line breaks) are ignored; could input entire program on one line (but this is bad form)

Programming errors

- **Syntax errors** (compile-time): violation of the language rules
  - Compiler can’t translate programs with syntax errors to bytecode
- **Logic errors** (run-time): valid Java program that can be compiled and executed, but the results are not correct
  - Nearly all software contains logic errors!

Eclipse/Ambient

- In this course, we will be using a freely available integrated development environment (IDE) called *Eclipse*
- Eclipse combines many useful programs together, including an editor, compiler, JVM, output console, and debugger
- Eclipse automatically compiles your program each time you save; it will also tell you immediately if you make a syntax error
- Also will use the Ambient plug-in, which allows you to easily submit homework and do other useful tasks