Introduction to Java Programming

Lecture 1 CGS 3416 Spring 2020

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Main Components of a computer

- CPU - Central Processing Unit: The "brain" of the computer
  - ISA - Instruction Set Architecture: the specific set of low-level instructions available to a CPU. Differs for various CPU types (Intel Pentium, Mac G4, etc)
- ALU - Arithmetic & Logic Unit responsible for performing arithmetic calculations, as well as logical operations (comparisons for equality, inequality, for instance).
- Main Memory (RAM - Random Access Memory)
  - storage close to CPU
  - Faster to access than hard disk
  - stores executing programs and data being currently worked on
- Secondary Memory
  - hard disk, floppy disk, CD, DVD, etc.

Main Components of a computer

- Input devices
  - mouse, keyboard, scanner, network card, etc.
- Output devices
  - screen/console, printer, network card, etc.
- Operating System
  - Examples: Mac OS, Windows XP, Linux
  - Controls computer operations
  - Manages allocation of resources for currently running applications

Memory Concepts

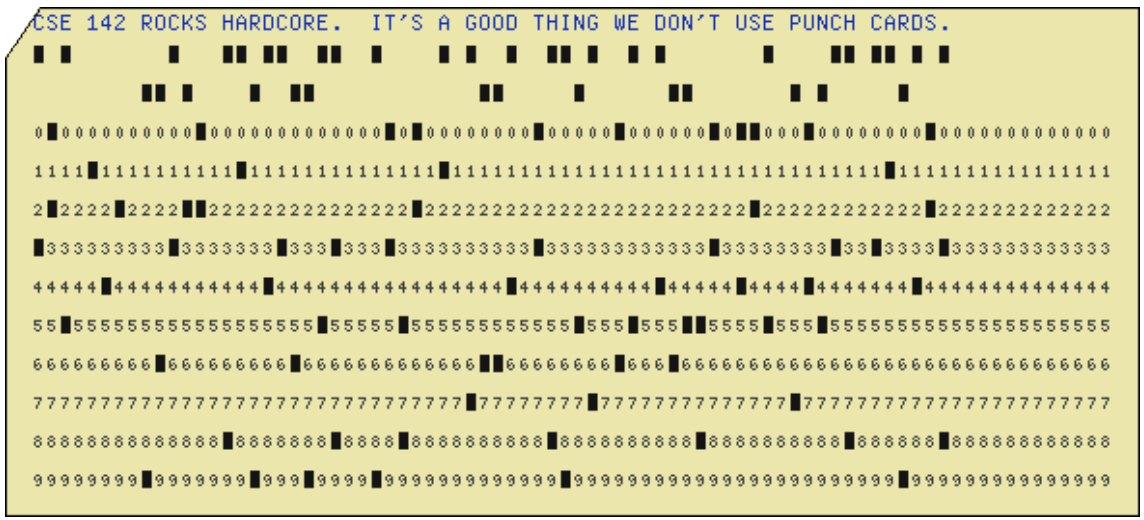
- bit: a binary digit
  - Stores the value 0 or 1
  - Smallest unit of storage in a computer
- byte: 8 bits
  - Smallest addressable unit of storage in a computer
  - Storage units (variables) in a program are 1 or more bytes
  - Each byte in memory has an address (a number that identifies the location)

Programming, and Programming Languages

Program - a set of instructions for a computer to execute

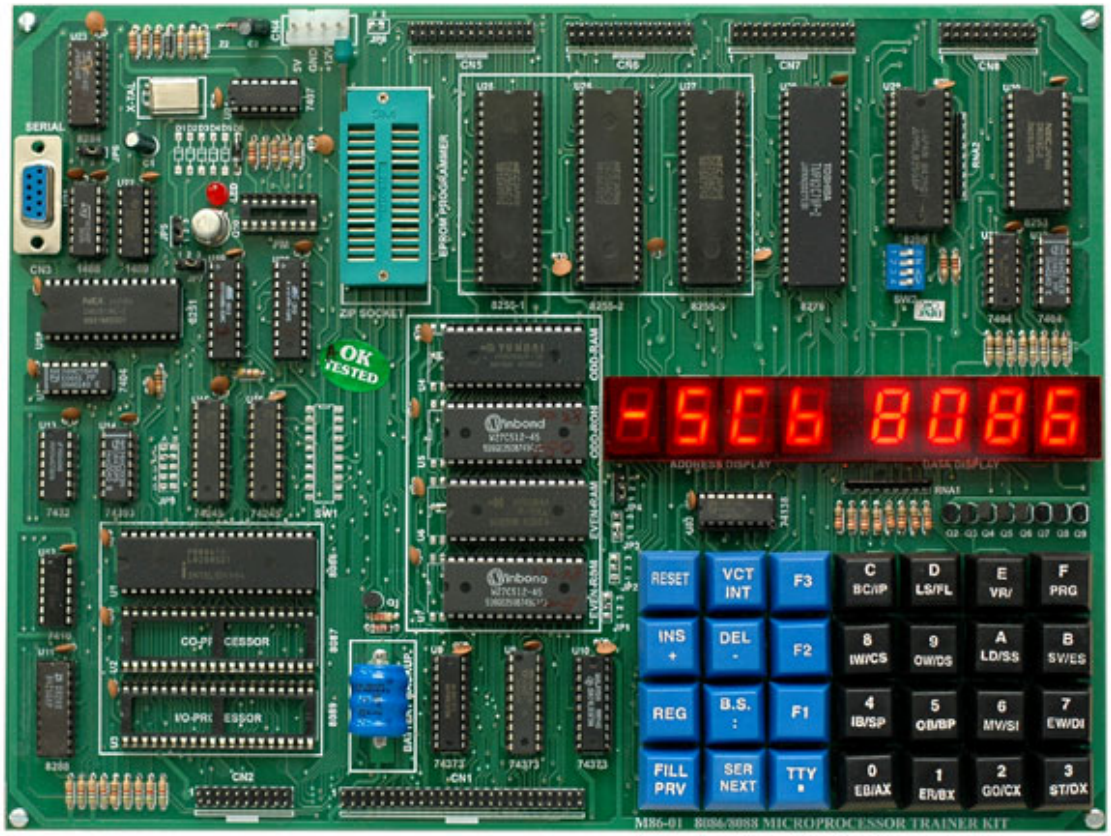
Evolution of Programming languages

- Machine Language
  - Based on machine's core instruction set
  - Needed by computer, hard for humans to read (1's and 0's)
  - Example: 11101101010101100011101010



Programming, and Programming Languages

- Assembly Language
  - translation of machine instructions to symbols, slightly easier for humans to read
  - Example: ADD $R1, $R2, $R3



Programming, and Programming Languages

- High-level procedural languages
  - Abstraction of concepts into more human-readable terms
  - Closer to "natural language" (i.e. what we speak)
  - Easy to write and design, but must be translated for computer
  - Examples include C, Pascal, Fortran
- Object-oriented languages
  - Abstraction taken farther than procedural languages
  - Objects model real-world objects, not only storing data (attributes), but having inherent behaviors (operations, functions)
  - Easier to design and write good, portable, maintainable code
  - Examples include Smalltalk, C++, Java

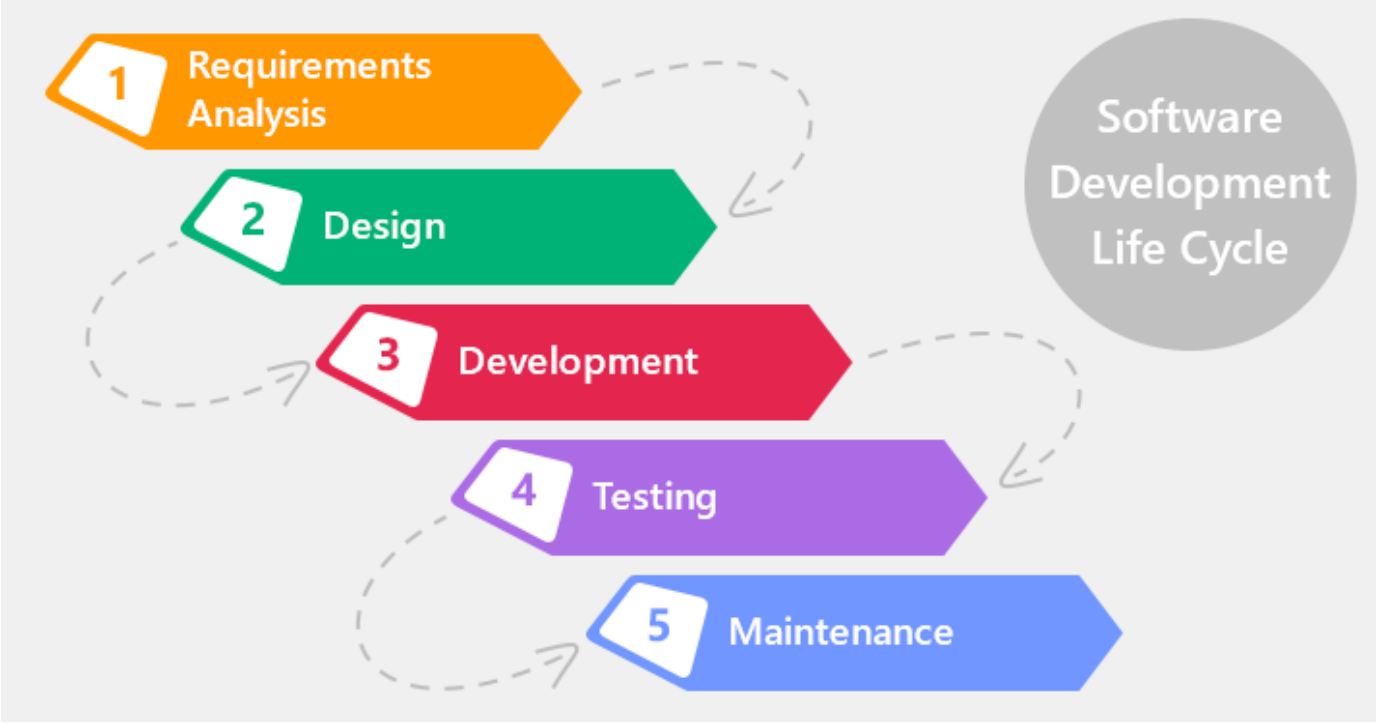
Code Translation

Bridging the gap between high-level code and machine code

- Interpreted languages – source code is directly run on an interpreter, a program that runs the code statements
- Compiled Languages
  - A compiler program translates source code (what the programmer writes) to machine language (object code)
  - A linker program puts various object code files together into an executable program (or other target type, like a DLL)
  - C and C++ are compiled languages
- Java is a mix of both!

Software Development

Involves more than just writing code



Software Development

- Analysis and problem definition
- Design - includes design of program or system structure, algorithms, user-interfaces, and more
- Implementation (coding)
- Testing - can be done during design, during implementation, and after implementation
- Maintenance - usually the major cost of a software system. Not part of "development", but definitely part of the software life cycle

The Java Language

- Java is a programming language that evolved from C++
  - Both are object-oriented
  - They both have much of the same syntax
- Began in the early 90's, originally used for programming in intelligent consumer-electronic devices (internal chips, etc).
- Was originally named Oak by its creator, but changed when it was reliazed that there was already a language called Oak
- When the Web took off in the early 90s, Java gained popularity for use in adding dynamic content to web pages
  - While applets surely helped Java gain quick popularity, they are by no means the most important use of the language

The Java Language

- Java is now used for a wide variety of purposes.
- Its large and rich set of pre-built packages makes it a very popular choice of software developers
- The Java language specification is owned and controlled by Sun Microsystems (An Oracle Company)
- API (Application Programmer Interface) documentation for standard libraries available on the Oracle website.
- Standard Development Kit, along with other development tools can be downloaded from http://www.oracle.com/technetwork/java/javase/downloads/index.html
- Latest version is Java SE 8 – Java Standard Edition 8.0

Compiling and Running a Java program

- Java code compiled to an intermediate level – bytecode
- bytecode runs on an interpreter – the Java Virtual Machine
- Each platform needs its own JVM, but the same bytecode (generally speaking) runs on any JVM on any platform (i.e. the compiled version is portable)
- Typically Slower runtime than languages like C++, since running on an interpreter (and due to other factors)

Basic Creation and Execution of a Java program

1. Create source code with a text editor, store to disk
   - Source code is just a plain text file.
   - In Java, we give the filename an extension of .java to identify it as a source code file
2. Compilation – The compiler does syntax checking, translation to bytecode in files with the .class extension
   - bytecode is a translation of the source code to an intermediate level of code
3. Execution of Java program
   - The loader is part of the Java Virtual Machine
   - It loads the bytecode into memory and executes the instructions via an interpreter for the given platform (Windows, Mac, Linux, etc)

Integrated Development Environments

- An Integrated Development Environment (IDE) is a software package that includes all necessary tools for creating a program. Typcially includes:
  - Text editor
  - Compiler
  - Loader
  - Debugger
  - Ability to launch and run applications from within IDE environment
  - Other useful tools
- Java IDEs frequently use the Java Standard Development Kit (SDK) tools underneath, and provide a graphical interface through menus to access the underlying tools. For this course, it is recommended that you use IntelliJ IDEA as an IDE. It's professional edition is available for free to students. It also has free community edition.
- Examples of Java IDEs
  - IntelliJ
  - NetBeans
  - Eclipse

Some Important Java Tools

- javac - java compiler
- java - java interpreter
- jar - the java archive utility
- javadoc - utility for auto-generating Java documentation API pages
- JSP - Java Server Pages
- JRE - Java Runtime Environment
- J2SDK - Java 2 Standard Development Kit (sometimes JDK, Java Development Kit, for short) – includes JRE

Programming is about Problem Solving

- Algorithm - a finite sequence of steps to perform a specific task
  - To solve a problem, you have to come up with the necessary step-by-step process before you can code it
  - This is often the trickiest part of programming
- Some useful tools and techniques for formulating an algorithm
  - Top-down Refinement: Decomposing a task into smaller and simpler steps, then breaking down each step into smaller steps, etc
  - Pseudocode: Writing algorithms informally in a mixture of natural language and general types of code statements
  - Flowcharting: If you can visualize it, it's often easier to follow and understand!

Programming is about Problem Solving

- Testing - algorithms must also be tested!
  - Does it do what is required?
  - Does it handle all possible situations?
- Syntax vs. Semantics
  - Syntax – the grammar of a language.
    A syntax error: "I is a programmer."
  - Semantics – the meaning of language constructs
    Correct syntax, but a semantic error: "The car ate the lemur."