Java Programming

Outline

- C, C++, and Java
- How Java is related to C and C++
- Advantages of Java
- Writing good codes in Java is easier than in C or C++
- Java libraries (packages)
- Where the power of Java come from

C, C++, and Java

- C designed in 1970's for operating system programming, i.e. UNIX
  - High-level language compared with assembly language
  - Low-level compared with C++ or ja programming, i.e. UNIX
  -
  - Low level = Easy manipulation of hardware
  - High level = Relying one lower level software to implement task with minimum amount of code.

Strengths

- Not restrictive, especially in relation to type conversion.
- More efficient than C++ and Java.
- Weaknesses:

Not object-oriented: does not support abstraction and encapsulation

Difficult to manage in large projects.

Little built-in functionalities. Programmer need to start from scratch.

Easy to make mistakes. (pointers, a=b vs a==b)

C, C++, and Java

- C++ designed in 1980's, complete superset of C
- Changes
  - Support for Object-Oriented programming

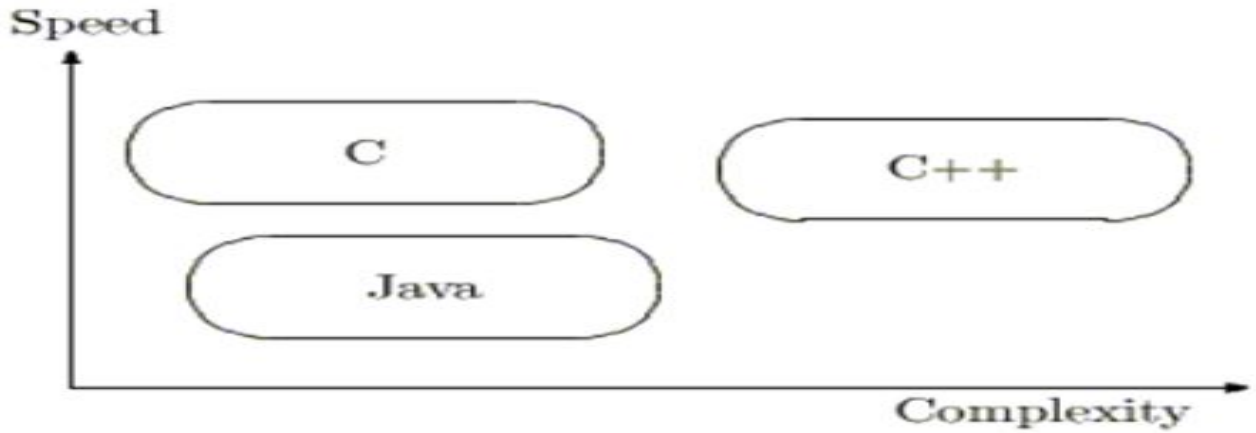
- Strengths
  - Improved data abstraction and encapsulation

  Makes it easier to manage large projects
  - More extensive built-ins (standard libraries)
- Weakness
  - Considered by many to be over-complicated
  - Contains all of C's problems

C, C++ and Java

- Java: a language of 1990's
- The design of Java starts with C syntax and semantics
- Adds a few features from C++: Objects, exceptions
- Leaves out parts unneeded, unsafe, complex (not backward compatible)
  - Gosling: "Java omits many rarely used, poorly understood, confusing features of C++ that in our experience bring more grief than benefits."
- Adds a few facilities not present in C or C++
  - Garbage collection, concurrency, runtime error checking, object serialization, interface, inner classes, threads
- Strengthens portability and security

C, C++ and Java



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- Java and the internet
  - What Java is good for
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Advantages of Java

- According to Sun's Java White paper:

  "Java is a simple, objected-oriented, distributed, interpreted, robust, secure, architecture-neutral, portable, high-performance, multi-threaded, and dynamic language".

- Most of the claims are justified, while others are controversial.

Advantages of Java/Simple

- Streamlined C language:
  - No typedef, union, enum, goto, comma operator
  - No header files
    - C: list.h, list.c
    - Java: List.java
- No makefile
  - Java compiler can figure out dependencies among classes

Advantages of Java/Simple

- Fixed problematic areas:
  - ○No pointers, no function pointers
  - ○Add garbage collection. Memory leaks no more
  - ○No code like this

```
    *Head == NULL ){
   *Head=(NODESET *) memAllocate(sizeof(NODESET));
   *(Head+5) = tmpNode;
   (*Head)->next=(*Head)->prev=NULL;
  }
memDeallocate( Head );
```

- “if (a=b)” does not compile

Advantages of Java/Simple

- Everything is class except several primitive types
  - Array is a class. Cannot go over bound.
    - No this
    - int a[5]; a[5]=0;
- However, Java libraries are quite complicated

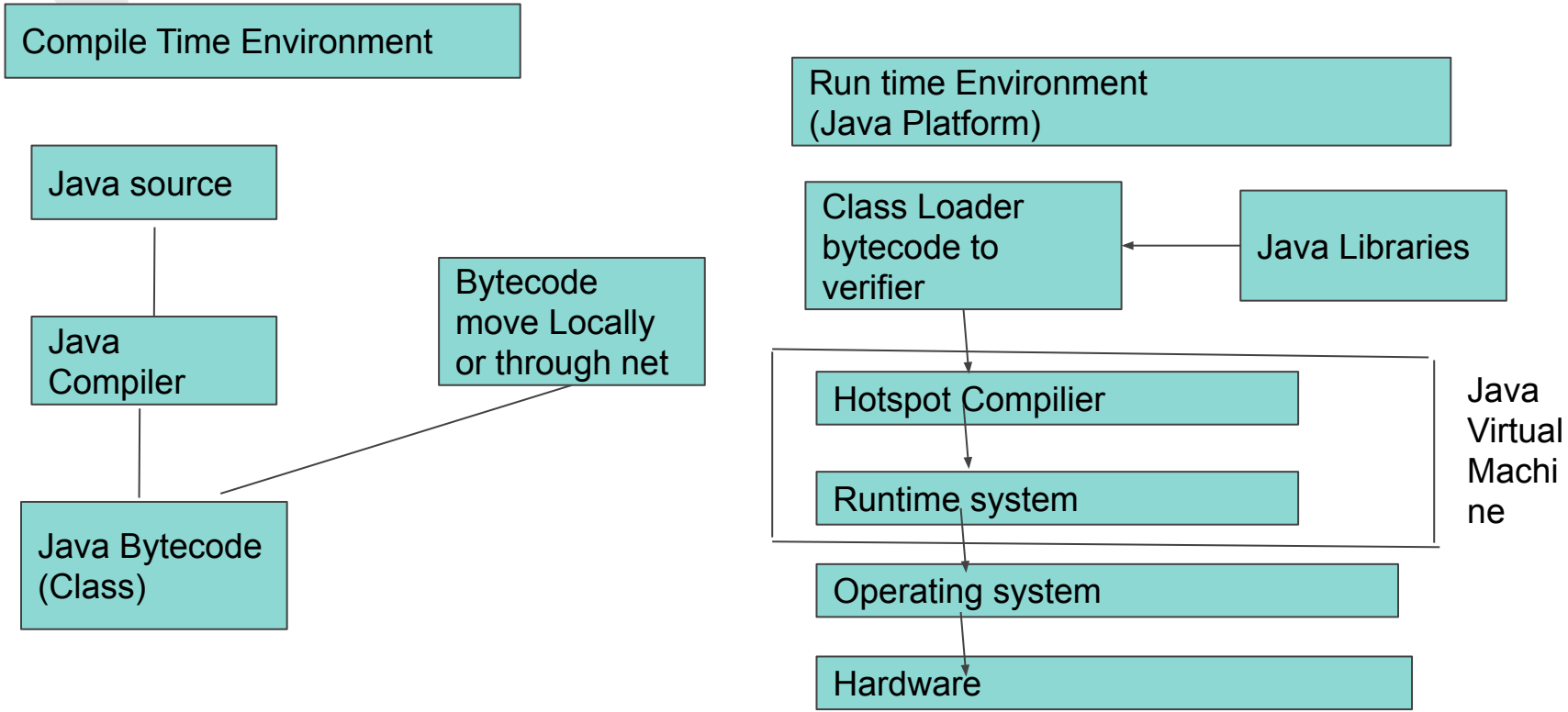
Advantages of Java/Object-Oriented

- More so than C++.
  - Combine data and behavior into one unit, the object
  - Programs are collections of interacting, cooperating objects
- Advantages of OOP
  - Provide strong data abstraction and encapsulation
  - Gives framework for design
  - Allows independent development and testing
  - Facilitates system extensions and maintenance
  - More opportunity for code re-use

Advantages of Java/Platform-Independer

- C and C++ programs are compiled into object code,
  - ○Object code is directly processed by hardware processor.
  - ○Require a separate compiler for each computer platform, i.e. for each computer operating system and the hardware set of instructions that it is built on.
- Java programs are compiled into bytecode
  - ○Bytecode is processed by a program called java virtual machine (JVM), rather than by the "real" computer machine, the hardware processor.
  - ○Platform differences dealt with by JVM
  - ○Consequently, Java programs can run on any platform. “Write once, run anywhere”.

Java Virtual Machine



Advantages of Java/Robust and Secure

- Fewer language loopholes
  - No pointers, typecasts limited. (Easier to produce error free source code)
- Compilers are strict
  - Require initialization of variables, enforces type consistency, requires prototypes (Less chance of error in compiled code code)
- Runtime error checking
  - Array bounds, null reference access (Less chance of runtime error)
- Security manager
  - System to control permissions for high-level actions
- Runtime verifier checks untrusted bytecode
  - Avoids havoc from hand-constructed bytecode

Advantages of Java

- In Summary, writing good codes in Java is easier than in C or C++

- javadoc generates documentation automatically
  - Very useful
  - Example: HLCM
- Now, I write all my programs in java

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Java Libraries

- Java has far expanded traditional scope of a language's libraries
  - Java 2 SDK 1.6:
    - More than 100 packages
    - More than 3000 classes
- Much less effort required to accomplish common tasks
- Platform-specific details are handled
- All programs improved when common core updated

Java Libraries

- Collection of classes grouped into packages

  Java equivalent of C libraries

- java.lang

  String, Math, Exception, Thread, Runtime, etc

- java.util

  Vector, Stack, hashtable, Date, Tokenizer

- java.io

  Varieties of input/output processing

- java.net

  Networking, client/server sockets, URLs

- java.awt, javax.swing

  Windows, buttons, drawing, images, events

Java Libraries

- Java.Security

  Encryption ,digital signature,message digest

- Java.text

  Formating and parising

- Java.sql

  Database connectivity

- Java.rmi

  REmote method invocation ,distributed objects

- The list goes on...

  And it is continuing to expand.Java is still Young

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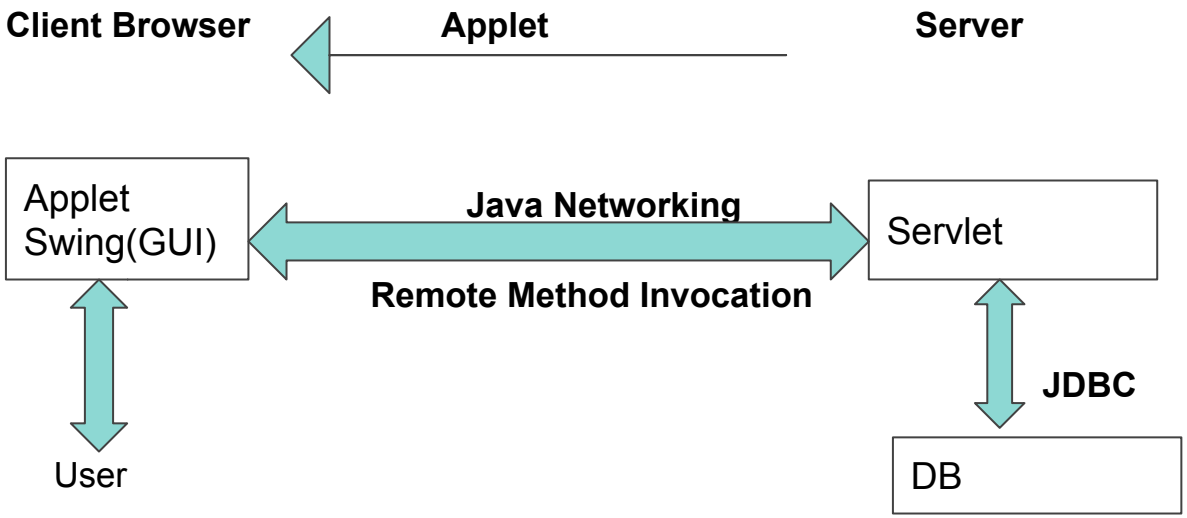
Java and the Internet

- Java is intended to be used in networked/distributed environments.
- Increasingly used for “middleware” to communicate between clients and serves, acting as a universal glue that connect user with information from various sources. Example: JMOL

  Made possible by portability and multithreading and networking capabilities



Course Contents

- Language Basics:
  - Classes, objects, inheritance, interface, inner classes, exception, I/O
- Components in the following diagram
- Other issues
  - Multithreading, security