

## B211 Internet Computing

# Programming Languages on the Internet: JAVA and Visual Basic

## Lecture Outline

- In this lecture, we will go through two important programming languages used for application development on the Internet today
  - JAVA
  - Visual Basic

## The Origins of JAVA

- Originally called Oak - designed and implemented by a team headed by James Gosling at Sun Microsystems in 1991/1992.
  - The team's (The Green Team) purpose wasn't even to create a new language - it was to *anticipate and plan for the "next wave" in computing.*
- The language was used in the new hand-held home-entertainment device they created
  - In response to using C++ which they considered to have too many limitations as a development language due to its complexity.

## The Origins of JAVA (cont'd)

- Based on C syntax, but aimed not to have the complexity of C++
  - To make it attractive to the big community of C/C++ programmers
  - The language was designed with ideas from Smalltalk, Eiffel, LISP, Objective C, and Cedar.
- JAVA 1.0 was introduced in 1995 with the release of the Java Development Kit (JDK) and took the Internet by storm.

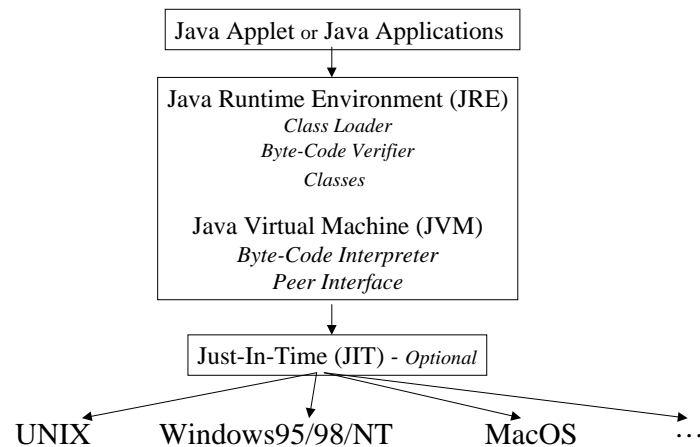
## The Origins of JAVA (cont'd)

- JAVA 1.1 released in early 1997, and JAVA 2 (JDK 1.2) in 1998.

## JAVA Executables

- JAVA can be written to be compiled into:
  - Applications
    - Behaves like any ordinary mainstream programs executed in a particular platform
  - Applets
    - Mini-applications embedded in HTML pages.
    - Downloaded from the server (where the HTML page is) to the client and executed by the client.
    - Not trusted, and subject to restrictions (eg. no access to local files and devices).

## JAVA Execution



## The Java Development Kit (JDK)

- Development in JAVA requires the JDK, released by Sun Microsystems
  - Most proprietary Java development environment built on top of JDK.
- Consists of:
  - Development tools, including compiler, debugger and interpreter.
  - Class libraries (called packages)
  - Demonstration programs
  - Supporting tools and components, like source code for the class libraries.

## JAVA Libraries

- To avoid putting too much into the core language and making it unnecessarily complicated, most useful features in JAVA are placed in their libraries.
- JAVA libraries come in the form of classes.
  - The classes are put together in packages which must be imported (using an `import` statement) by a program.

## JAVA Libraries (cont'd)

- Three broad categories of JAVA libraries:
  - Core libraries
    - bundled with JDK and includes APIs (application programmers' interfaces) which must be supported all JAVA implementations.
  - Standard Extensions
    - optional, mostly distributed with JDK.
  - APIs for specific hardware or application areas.

## JAVA Core Libraries in JDK 1.2

- JAVA Language and Utilities classes
- File I/O
- Graphical User Interface – including AWT (Abstract Window Toolkit) and Swing.
- Network communications – mainly through TCP/IP.
- Database connectivity – to SQL databases
- Distributed objects
- Security – digital signatures, encryption, authentication.
- JavaBeans
- JAVA Media 2-D graphics and audio.

## JAVA Standard Extension Libraries in JDK 1.2

- Java Media
- Java Mail
- InfoBus
- Java Communications API – for serial and parallel ports
- Java Help
- Java Enterprise APIs – for building large-scale software applications that run on entire organizations.

## JAVA in the Operating System

- To allow JAVA programs to run, special software has to be available:
  - JAVA applets runs anywhere which has a browser supporting the Java Virtual Machine (JVM).
  - JAVA applications require Java Runtime Environment (JRE) to exists before being able to execute the JAVA bytecode.
- Many leading companies have committed to embedding the JVM directly into their OS.

## JAVA Servlets

- As oppose to JAVA "applets"
- An API to support writing server-side JAVA components
- Usually coupled with JSP for a full server-side solution.
- Requires the JAVA Servlet Development Kit (JSDK)

## Keys to JAVA's Current Success

- Syntactic similarity to C
  - ease of migration for C/C++ programmers when JAVA was first released.
- Enforcing OO concepts and removing omitting features of C++ which are sources of most problems for C++ developers.
- Current wide-spread developments in new libraries and extending existing libraries.

## Keys to JAVA's Current Success (cont'd)

- Platform independence and open source philosophy.
- The commitment of major companies to incorporate JVM into the OS.

## Programming Language Design Criteria

- Efficiency
  - In execution of programs
    - how fast (time) can it run and how much resources, usually memory (space), it requires.
  - In translation of programs
    - this means how much time and resources it takes to compile source code to a executable,
    - in cases where source code are interpreted, the efficiency of interpretation is the same issue as the efficiency of execution.
  - In implementing the translators
    - how easy (time and space) is it to implement and develop a translator – compiler, linker, interpreter, run-time engine, etc.

## Programming Language Design Criteria (cont'd)

- Efficiency (cont'd)
  - In writing programs
    - to be able to express the computation clearly, correctly, concisely and quickly.
  - In reading and maintaining the programs
    - to understand the computation easily and accurately
- Generality
  - avoids special cases
    - Eg. Having an operator = being applicable to all data types, having arrays of any dimensions rather than just two dimensions, etc.

## Programming Language Design Criteria (cont'd)

- Orthogonality
  - language components can be combined in meaningful ways without undue restrictions
    - Eg. Functions able to return different types, parameters can be passed in consistent ways, etc.
- Uniformity
  - Similar constructs look similar, and different constructs look different
    - Eg. Consistent delimiters for all blocks, use of symbols for pointers referencing/dereferencing, etc.

## Programming Language Design Criteria (cont'd)

- *Generality*, *Orthogonality* and *Uniformity* are more abstract properties of the languages, aimed at making it cleaner to program
  - Most people consider these three criteria to be special cases of the listed *Efficiency* criteria.

## JAVA vs C/C++

- We have mentioned many language differences between JAVA and C++. Most differences is because JAVA designers wanted to
  - improve on the platform independence of the language
  - improve generality, orthogonality and uniformity, as well as efficiency in writing and maintaining programs

## JAVA vs C/C++ (cont'd)

- One area C/C++ still wins out is in efficiency of execution.
  - The estimate for the first version of JAVA is that an equivalent C/C++ program will run 10 to 20 times faster.
  - This estimate decreased by half in version 1.1 and then JAVA 2.
  - With JAVA Just-in-Time (JIT) compilers, the estimate is that C/C++ programs will only be twice as fast.
    - JIT compilers compile the byte-code to OS-specific machine code at run-time. The machine code runs faster than the JVM executing byte-code.

## JAVA vs C/C++ (cont'd)

- There are also other implementation issues:
  - JAVA programs will always require JVM to execute.
  - Some programs (especially systems programs) cannot be written in JAVA due to lack of control over memory management.
- Internet application programmers seems to not place as much emphasis on such issues.

## Visual Basic

- Visual Basic is a programming language and environment developed by Microsoft
  - based on the BASIC language.
- Visual Basic contains the basic 3GL language constructs, but aimed at very quick development of MS-Windows application.
- Although not a completely object-oriented language, it follows very much in the OOP philosophy
  - all objects respond to different events such as mouse clicks
  - it is commonly called an *event-driven* language.

## Visual Programming

- Visual Basic was one of the first 3GL language products to provide a graphical integrated development environment (IDE) with drag-and-drop approach for developing user interfaces.
- Visual Basic is sometimes called a *Rapid Application Development* (RAD) system because it enables programmers to quickly build prototype applications.

## Visual Programming (cont'd)

- Ignoring syntax details, the programmer can add a substantial amount by simply dragging and dropping controls, such as buttons and dialog boxes, and then defining their appearance and behaviour.
- Today, there are visual environments for many programming languages, including C, C++, Pascal, and Java.

## VB Controls

- When developing applications in any VB environment, programmers have available a set of built-in objects called *controls*.
- These controls are reusable component which programmers can incorporate into their applications.
  - Eg. VB6 (the current version) comes with the following controls: checkbox, textbox, horizontal scrollbar, dirlist, timer, etc.

## VB Controls

- Extra controls (in the form of ActiveX controls, in .ocx files) can be imported by registering them in the Windows Registry
  - Eg. ADO (ActiveX Data Object – for database access), Animation, Internet Transfer, MSChart, Slider.
- Not all ActiveX controls can be incorporated into a VB application
  - depends on the how the control was implemented.
- Most commercial ActiveX controls are only to be used and not included in other applications.

## The Keys to VB's Success

- The attractiveness of Drag-and-drop application development (the concept of visual programming) while still having an underlying full 3GL language.
- Due to its visual programming approach and its event-oriented nature, creating GUI is very easy
  - most times, GUI creation is the achilles heel in making an application prototype.
- Continuing availability of richer sets of controls.

## The Keys to VB's Success (cont'd)

- Easy integration with other Microsoft products and technologies, eg. database management with Microsoft SQL Server.

## Further Information

- Some tutorials on Java
  - <http://www.javasoft.com/docs/books/tutorial/index.html>
  - <http://www.ibm.com/java/education/intro/courseoptions.htm>
- Up-to-date news on JAVA
  - <http://java.sun.com/>
- Microsoft's site for VB:
  - <http://msdn.microsoft.com/vbasic/>

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