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Java and its Impact on the Internet

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Abstract

Traditionally, when people access the World Wide Web (WWW) using web browsers, they can only read two types of "stuff": text and graphics. Java was invented so that web browsers not only are used to download text files and graphics files, but also actually programs. Generally speaking, Java is a new software technology that allows users to download computer programs off the Web, which then runs inside a web browser. The way Java works is simple. Unlike ordinary software applications, which take up megabytes on the hard disk of a PC, Java applications, or "applets", are little programs that reside on the network in centralized servers (powerful computers dedicated to specialized uses). The network delivers them to users' machines only when needed. However, the real beauty of Java is its power to save users money. Java programs, once written, can run without modifications on just about any kind of computers hence vastly simplifies creating and deploying applications and consequently "relive" existing "legacy" computers and software infrastructures. Eventually, Java will make possible the rapid development of versatile programs for communicating on the Internet; also, it will make possible a new class of cheap machines called network computers which will be proliferate in corporations and homes.

Java and its Impact on the Internet

1.0 Introduction: Internet History

The Internet began as the ARPANET during the cold war in 1969. It was developed by the US Department of Defense's (DOD) research people in conjunction with a number of military contractors and universities to explore the possibility of a communication network that could survive a nuclear attack. It continued simply because the DOD, it's contractors, and the universities found that it provided a very convenient way to communicate.

For the first decade that the Internet was in existence, it was primarily used to facilitate e-mail, support on-line discussion groups, allow access to distant databases, and support the transfer of files between government agencies, companies and universities.

During the early 1980s, all the interconnected research networks were converted to the TCP/IP protocol (this enables all of the networks of the Internet to send data back and forth), and the ARPANET became the backbone (the physical connection between the major sites) of the new Internet, which comprised all TCP/IP-based networks connected to the ARPANET. This conversion to TCP/IP was completed by the end of 1983 - and the Internet was born.

In 1990, HTML, a hypertext Internet protocol which could communicate the graphic information on the Internet, was introduced. Each individual could create graphic pages (a Web site), which then became part of a huge, virtual hypertext network called the World Wide Web (WWW). The enhanced Internet was informally renamed the Web and a huge additional audience was created.

Recently, the World Wide Web itself has captured the attention of the Internet community as much as Java. Java, the Web programming technology developed by Sun Microsystems, has the potential to forever change the course of software development, especially in regard to the Internet. Java sports all the features necessary for extending the Web in ways previously impossible. Originally starting as part of an advanced consumer electronics project at Sun Microsystems Inc., Java was designed with issues such as portability (the ability to run unmodified on various platforms) in mind. This issue, among many others, are of paramount importance for applications that are to run on the Internet.

Java has stirred up such excitement mainly because of what it makes possible on the Web. On-line sound and animation were first introduced in Web pages thanks to Java. Interactive Web pages, including games implemented in Java, were the next logical application of the Java technology. Because of Java, the entire concept of the Web is being redefined.

2.0 Characteristic of Java as a programming language

As a new type of programming language, Java does everything other programming languages do but in addition, it also have unique features which makes it a ideal choice for the "Internet" applications.

2.1 Overview of Computer Programs, Computer Languages and a Compiler

Although it has been 50 years since the first computer was invented, the way people use computers remains virtually unchanged: a program must be created which consists of a specific set of ordered operations for a computer to perform. Typically, the program is put into a storage area accessible to the computer. The computer gets one instruction and performs it and then gets the next instruction. The storage area or memory can also contain the data that the instruction operates on.(Note that a program is also a special kind of "data" that tells how to operate on "application or user data.")

To create a program, a developer write it using some kind of computer language. In many aspects, a computer language resembles a human language which consists of both syntax (how the various symbols of the language may be combined) and semantics (the meaning of the language con structs). A computer language could be very “low level” if they are close to machine code (the representation of a computer program which is actually read and interpreted by the computer); or, it could be “high level” if each language statement corresponds to many machine code instructions. “High level” computer languages are almost exclusively used to create programs because they are much easier to learn and source files are more compact, compared with “low level” languages.

Typically, a programmer writes language statements in a high level language such as Pascal or C one line at a time using a text editor. But, in order to let a computer understand these statements, the programmer must use a special program called “compiler” to convert these statements to machine language format. When executing (running), the compiler first analyzes all of the language statements syntactically one after the other and then, in one or more successive stages, builds the output code, making sure that statements that refer to other statements are referenced correctly in the final code. Traditionally, the output of the compilation has been called object code- the machine code that the processor can process or “execute” one instruction at a time.

2.2 Java Is Architecture Neutral and Portable

Because Java programs may be downloaded into machines over the networks, it has been used with a variety of CPU (the part of a computer which controls all the other parts) and operating system architecture (the low-level software which handles all the basic functionalities of a computer system). To achieve this design goal, a special compiler was introduced that produces “byte-code”-- a new “virtual machine code” that is architecture neutral or in other words, executable on any computer system platform for which Java “virtual machine” is provided to converted the “bytecode” into instructions that can be executed by the actual hardware (the physical, touchable, material parts of a computer). This architecture works, not only for networks, but also for standard software distribution. With Java, a programmer can create a single executable piece of code that r can run on any computer having the Java runtime environment, as shown in Figure 1.

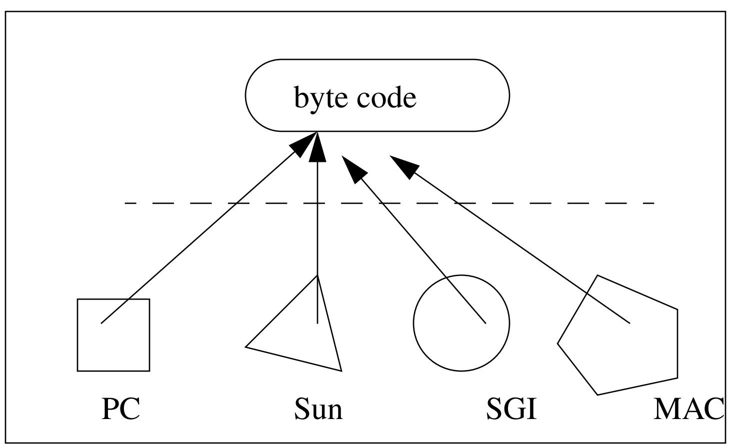

Figure 1. Bytecode: run anywhere

Thanks to a Java “bytecode” compiler, it is now possible to generate bytecode instructions that are completely independent of computer architecture. Such bytecodes can be interpreted on any machine and dynamically translated into native machine code as they come down the wire. Also, because its architecture-neutral capabilities, the Java system is highly portable.

Before Java was invented, high level languages such as C and C++ were touted as being highly portable. But in reality, they still are suffered from being implementation-dependent. That is, the size of primitive data types (variables with predefined characteristics), and the arithmetic per formed on them, changes from system to system. For instance, An ***int*** (a integer data type) on one system isn't necessarily the same size as an ***int*** on another. As a result, ease of portability degenerates.

In Java, however, primitive data type sizes and the behavior of arithmetic on these types are explicitly specified. For example, **i*nt*** is always a signed 32-bit integer value, and float is always a 32-bit floating point number conforming to the Institute of Electrical and Electronics Engineers' IEEE 754 specifications. Therefore, the representation and arithmetic behavior are consistent from system to system. Also, these consistencies make it possible to have the assurance that any result on one computer with Java can be replicated on another.

2.3 Java is robust and secure

Robust software doesn’t break easily because of programming bugs or logic errors in it. A programming language that encourages robust software often places more restrictions on programmer when he or she is writing the source code. These restrictions include those on data types and memory accesses. Also, because Java works in networked environments, the issue of security is one that should be of concern to developers. Plans are in the works for Java to use public-key encryption techniques to authenticate data.

3.0 How does Java transform the Internet?

Generally speaking, Java plays an very important role in shaping the future of the Internet and it does that in the following ways:

3.1 Java Spices up the Web Pages

First, Java makes Web pages sexy by incorporating stock tickers, sound or video into Web pages. It has evolved into much more. It is becoming known as a computing platform -- the base upon which software developers can build applications. Developers can build a variety of applications using Java -- traditional spreadsheets and word processors in addition to mission critical applications used by the biggest companies: accounting, asset management, databases, human resources and sales.

Java applications, are different from ordinary applications in that they reside on the network in centralized servers. The network delivers the applet to a user's system when he/she requests them. For example, let's say that a user want to check his/her personal financial portfolio. He/she would dial in to the financial institution and use a Web browser to log into the bank's system. The portfolio data will be shipped to the user along with the applet needed to view it. Let's assume that he/she is considering moving some money from one account to another. The system will also send to a user, an applet that will allow him/her to change the rate of interest and length of investment to perform a series of "what-if" scenarios.

3.2 Java allows for the creation of "executable data"

When first web browsers (before the invention of Java) were created, they were design to understand only specific data types such as HTML and graphics files. However, the explosive growth of Internet had since spurred the demand for the number of data format needed to represent many new kind of informations on the internet. For these new data formats, the web browsers had to resort to external viewer programs to make them "understood" by computer users. The necessity of the presence of the local viewer programs had imposed a limitation on the information distri bution through the Internet because usually, information residing on the “cyberspace” are subject to more frequent changes and updates than these local viewing applications.

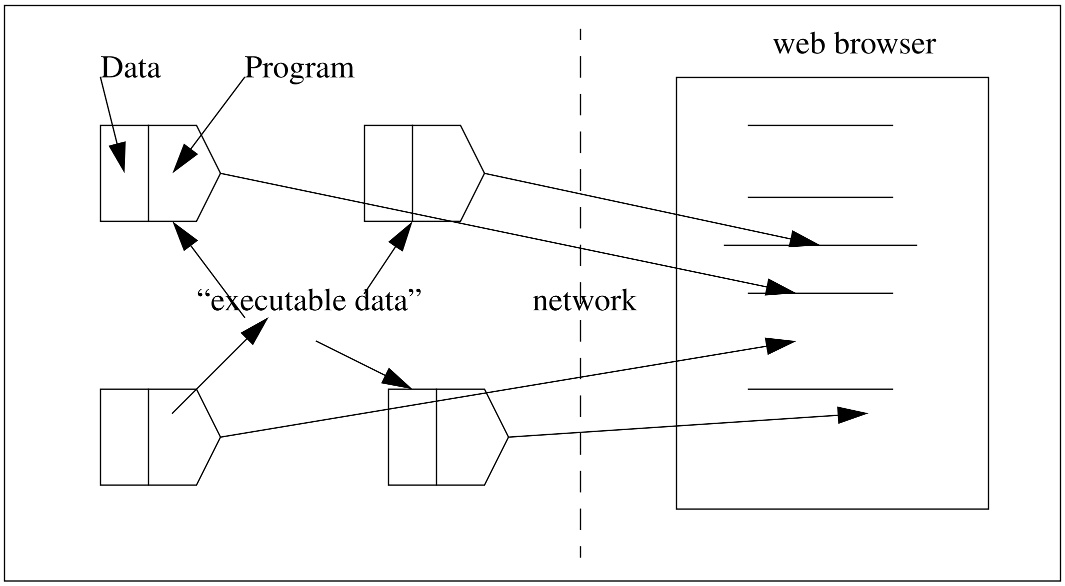

Figure 2. Executable Data: smart data knows how to “express” itself

To fundamentally eliminate the aforementioned limitation, Java provides a way of creating a “executable data”. Executable data can be thought of as a hybrid entity of a viewing program and the actual data. When this “executable data” is downloaded by a java-enabled web browser, the little viewing program, also written in java, will be invoked to run inside a web browser to carry out the function of an external viewing programs needed otherwise. From an information distributor’s point of view, “executable data’ would allow the data intended for mass media to be delivered to users in the shortest amount of time because in this case, users no longer need to download external viewers. In that sense, Java is the only thing a web browser really needs to understand.

3.3 Component Based Software

Once every several months, an average computer user will spend a few hundred dollars to buy a new version of the software-- this is called upgrade. What he gets in return is a big box of software application that he will use on a daily basis. The fact is that amount of functions he is getting is much more than what he will need to do his job. Taking Microsoft Word as an example, surveys conducted by Dataquest Inc shows that an average corporate user will never use more than 5 percent of the features offered inside the complete Word package. Therefore, what a user really spend money on is only a small set of new features which he will probably never use.

Java revolutionizes the way which software applications are being created and distributed. By using Java, various little piece of code called "applets" are created, each carrying a unique function. These little applets will be able to "collaborate" with each other, so with many of these applets together, a full-fledged application with just the desired functions can be formed. The big deal is to save money. These applets, each costing several penny, are maintained and upgraded independently by different sources. Imagine the following scenario, if Microsoft decides to update the spell checker in Word, he/she will have to pay $199 to get it; however, in the case of component based software, a user only needs to pay a few penny, just to get the updated spell checker applets, then the new applets, pretty much the same way as a module, needs only to be plugged into his component-based text editor to enable new features.

3.4 Network Computing and Network Computer

Usually, the Internet gives most people an impression that it is just a bunch of network bridges and routers interconnecting between computers. Well, with the advent of Java, the whole picture of the Internet needs to be sketched again by applying a little bit unconventional wisdom. To summarize the big picture, the internet itself means more than just a network of networks, we can think of the Internet as a gigantic loosely-coupled multi-processor super-computer with infinite amount of processing power and storage spaces. In the example of the component based software, many little applets, collaborating to form applications, can be spread around on different computers and leverage the distributed resources efficiently.

Finally, Java stimulates the demand for so-called network computers by providing a technology foundation upon which the distributed computing would prosper. The fact that Java, as a result of its portability, can download any program or application one needs onto the computer, as and when he/she needs it, may well be the way of the future. Software can be distributed from servers to clients (network computers), for which the client pays a “rental charge”

4.0 Conclusion

Still at its infancy stage, Java has long ways to go in fulfilling all its promises. For example, Java's bytecode execution speed is around 5/10 times slower than the equivalent code written in native machine language. This alone, can potentially hinder the migration of performance-critical applications and slow down the general acceptance of Java. Currently, effort has been paid target at both soft and hard end of the problem. At the software end, a Just-In-Time compiler, which translates the bytecode into native machine code on the fly, is created and a 10-20 times speed-up has been observed. On the other hand, at the hardware end, a set of chips named Java chips are designed which implements the byte code as their native code or in other words, these chips only understand byte code; as a result, another 10-20 times speed-up is achieved when java programs are run using Java chips.

With Java, a revolution on the Web has been ignited. The internet is still undergoing a major change from the way we used to know it, a static information repository, to a dynamic data distribution channel and a new kind of computing platform and of course, the presence of Java technology is of paramount importance to the success of such a transition.

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