Web-based C++ Compiler

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Abstract

This paper reports the successful use of Web-based interface to C++ compilers. There are several benefits that make networked software desirable. A web-based application can be used remotely throughout any network connection. Any operating system can be used to access it, making it platform independent. There is no local installation or maintenance work necessary. Access can be controlled and limited if required by software license agreement. Internet Compilers Package (ICP) is an example of a networked software-engineering tool. Different compiler packages can be used for various stages of application development providing either maximum error detection or code optimization.

Introduction

During the process of software development frequently more than one compiler package is required. Some products are known to be very useful for locating errors or debugging, while others perform extremely well when a program or library is in the final stage of development and should be optimized as much as possible. Also when facing obscure error messages, which may result in a time-consuming search for the error, a different error message from the second compiler frequently cuts that time dramatically.

Therefore students should be to some extend exposed to different compilers at some point in their software courses curriculum. Although all necessary software is installed in the computer laboratories, most students prefer to work on their computers at home or dormitory and connect to the university network. That situation creates unnecessary burden either for the network administrators who have to install additional software on many machines of non-standard configuration, or on students who must purchase and install on their own several software packages along their full course of study.

In order to solve the problem at least partially in the area of programming a software package was developed that allows for Web-based interfacing of various compilers. Three compilers: GNU, Microsoft, and Borland (Inprise) are used in the Bradley University intranet. Web-page based front end allows to access them without any restrictions regarding the computer system requirements thus allowing for their use on different operating system platforms and also on older machines with lesser performance. Access to selected commercial software components is enabled based on the user's computer name and IP address, and also limited by password system.

ICP can be used instead of purchasing a software license for each computer. In general this type of software can be used on a pay-per-use basis[1]. A similar trend exists in electronic publishing (e.g. IEEE Transactions, books from O'Reilly), where readers are asked to pay per access to the material, instead of purchasing journals, books, or abstracts, and IEEE is a driving force there.

Intranet Compilers Architecture

During software development it is important to justify which part of the software should run on the client machine and which part should run on the server. Client side programs - applets are transferred through network when requested and execution is performed entirely on the client machine that made the request[2]. This allows for sharing the computational cost between the server and client. It approach can be used when programs to be transferred to users are moderate in size or are be cached on client machine, or the data to be transferred between server and client, in case the application is run on the server, are very large in volume. In case of platform independent solutions, such as Java, causing lesser computational performance may be prohibitive[3,4].

With CGI much less information has to be passed to the server. The server executes instructions based on the given information and sends the results back to the local machine that made the request[5]. This is used in the opposite cases, when the software package is large or should not be released to user, or when amount of data to be transferred is small. However, large number of clients that access the server simultaneously would make CGI-based approach undesired.

CLIENT   **SERVER**

| Graphical User Interface of Computer |

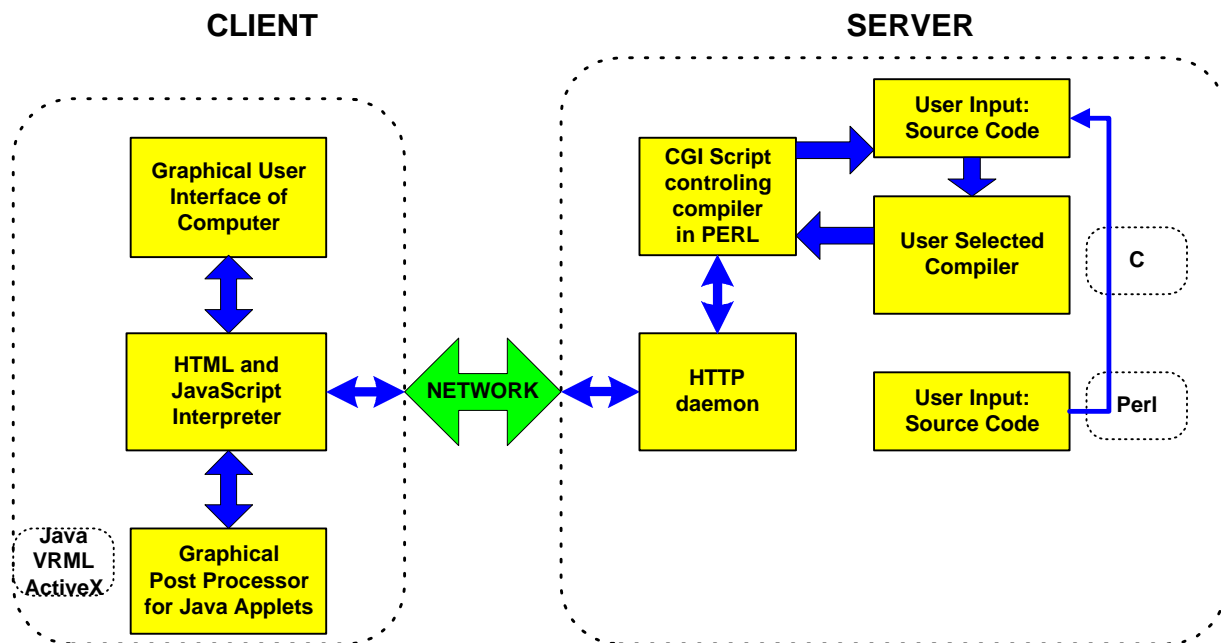| Graphical User Interface of Computer |
| HTML and JavaScript Interpreter |
| NETWORK |
| HTTP daemon |
| CGI Script controling compiler in PERL |
| User Input: Source Code |
| User Selected Compiler |
| C |
| User Input: Source Code |
| Perl |
| Java VRML ActiveX |
| Graphical Post Processor for Java Applets |

Fig. 1. Data flow in an Internet Compilers package.

These software design problems were considered and solved in the ICP. The user interface is programmed in HTML enhanced with JavaScript. The purpose of the project was allowing students to get familiar with different compilers and compiler optimization techniques rather than

make another huge GUI application to wrap compilers. Therefore, it is assumed that the user will use his or her favorite text editor to create and correct program files. This assumption allowed to create the very simplified front-end that loads quickly and is really platform independent that is shown later in Fig. 2.

The server side part of the application is implemented using CGI scripts written in PERL that handle communication between a user and different compilers. The data flow of the complete application is shown in Fig. 1. That script does the file managing, runs compilers and processes the compilation results[6]. The result is both the source code listing and a binary code to download or a list of errors sent back to the user.

To use ICP, paste the program code from your compiler text editor, or from any text editor, to the web page form. Then submit the form. The compilation will be performed by PERL script on the server in batch mode. Although the front end is designed to be as simple as possible with only a few commonly used options, it is sufficiently functional and can be used quickly. The PERL script located on the server has to deal with the translation of these common options to the actual options of compilers from different vendors. It also handles the compilation errors and processes the report.
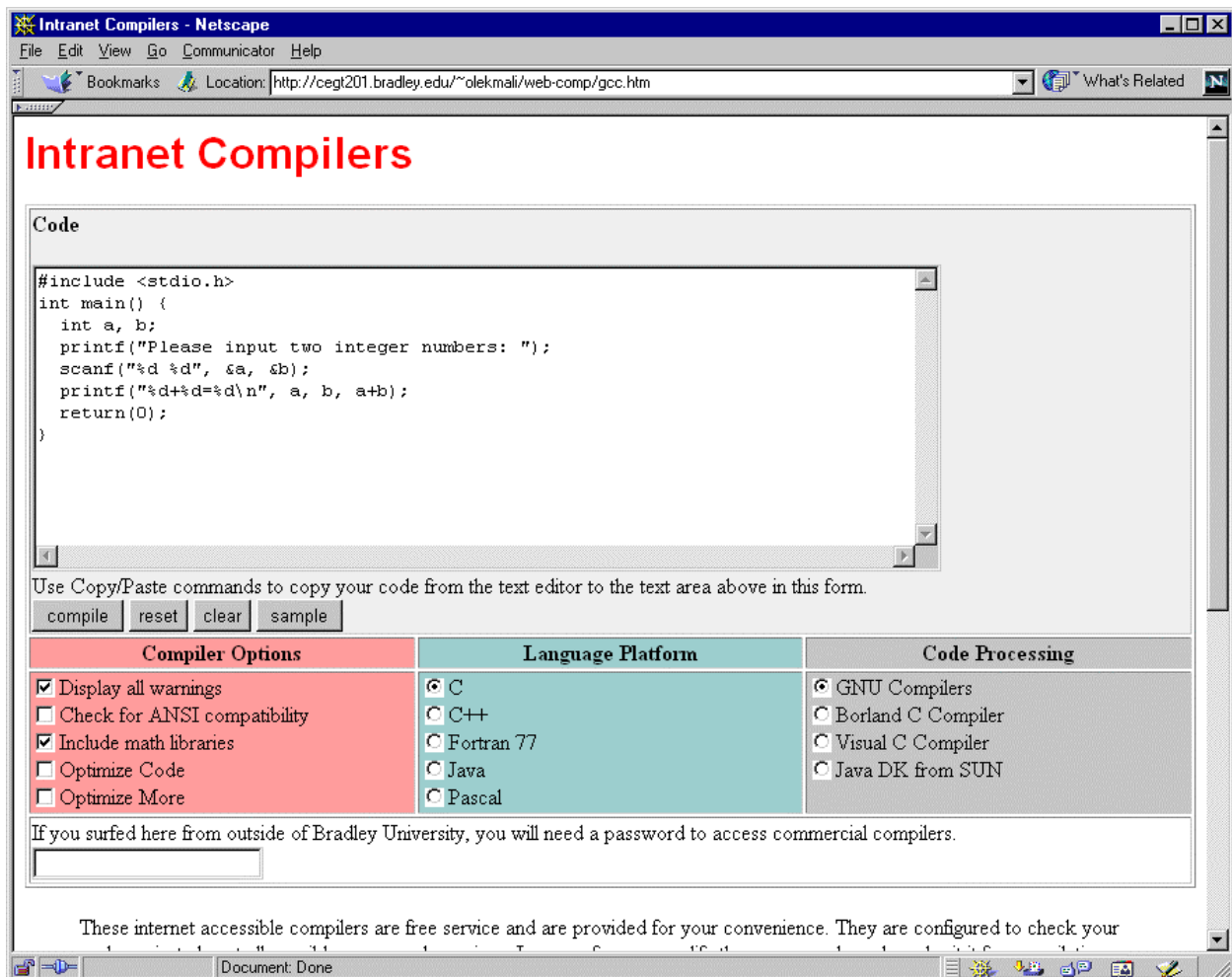

Fig. 2. The common web-based front-end to C++ compilers

Intranet Compilers User Interface

A common front end is used for all compilers, and is presented in Fig. 2. This HTML page allows for selecting a vendor and a language, and for setting a few basic compilation options. User uses copy and paste commands to enter the source code into the compiler front end. There are three menus located under the source code area as shown.

The middle menu is used to select the programming language while right menu is used to select the compiler vendor. Currently the Intranet Compilers package supports C, C++, Pascal, Fortran, and Java languages. It utilizes DJ GNU (ver. 2.91), Borland (ver. 4.5), and Microsoft (ver. 5) compilers for C and C++, GNU compiler for Fortran and Pascal, and Sun's JDK for Java. At this moment partial compilation into assembly language is supported only for GNU and Borland compilers.

One of preset compiling configuration can be selected from the left menu. User can decide whether aggressive binary code optimization or strict error checking and ASNI style violation checking are necessary. The compiler vendor and version can be selected from the right menu. In case of selecting one of commercial compilers while working at off-campus location user is requested to input a password to verify his or her legibility to use licensed products.

One of the major advantages of consolidating more than one compiler is the ability to cross-reference error message among different vendor products used from the same interface.

The process of compilation is performed in batch mode. After setting the desired options and pasting the source code into the appropriate text box, the task can be started by pressing the **COMPILE** button. As a result another web page with HTML wrapped information is sent back to the user. The result page is displayed in another browser window so that the user can correct the source code in the original window and resubmit it if necessary.
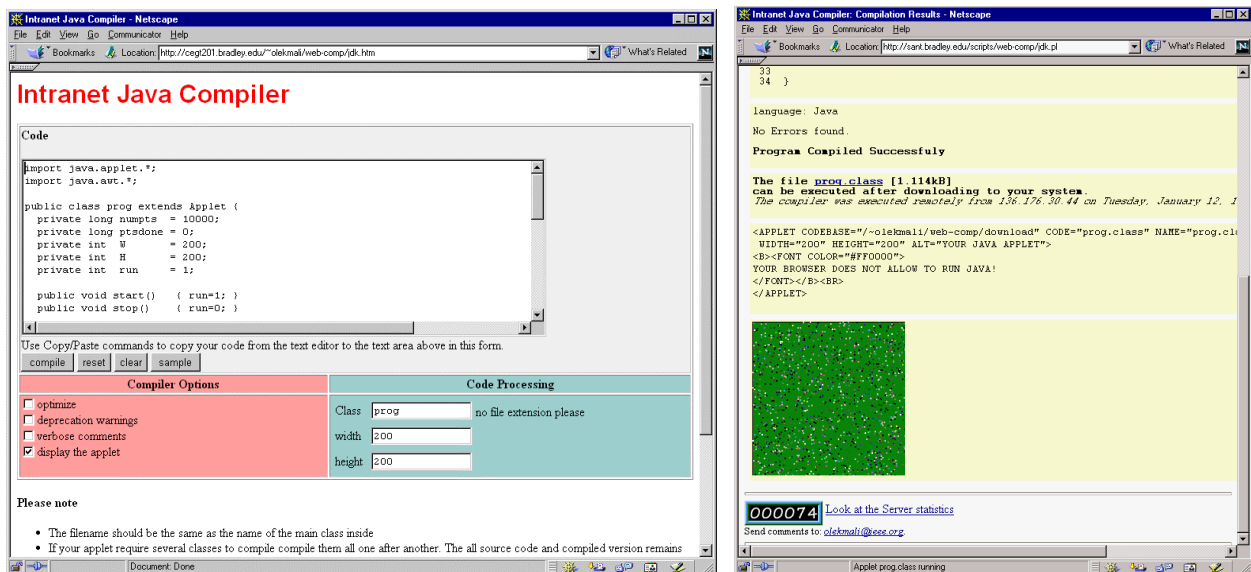

Fig. 3. Specialized front ends for Java (right) and the result page (left).

After successful compilation the binary code is available for download. If the user's operating

system agrees with the destination platform set for the compiler the binary code may be executed with full user interaction.
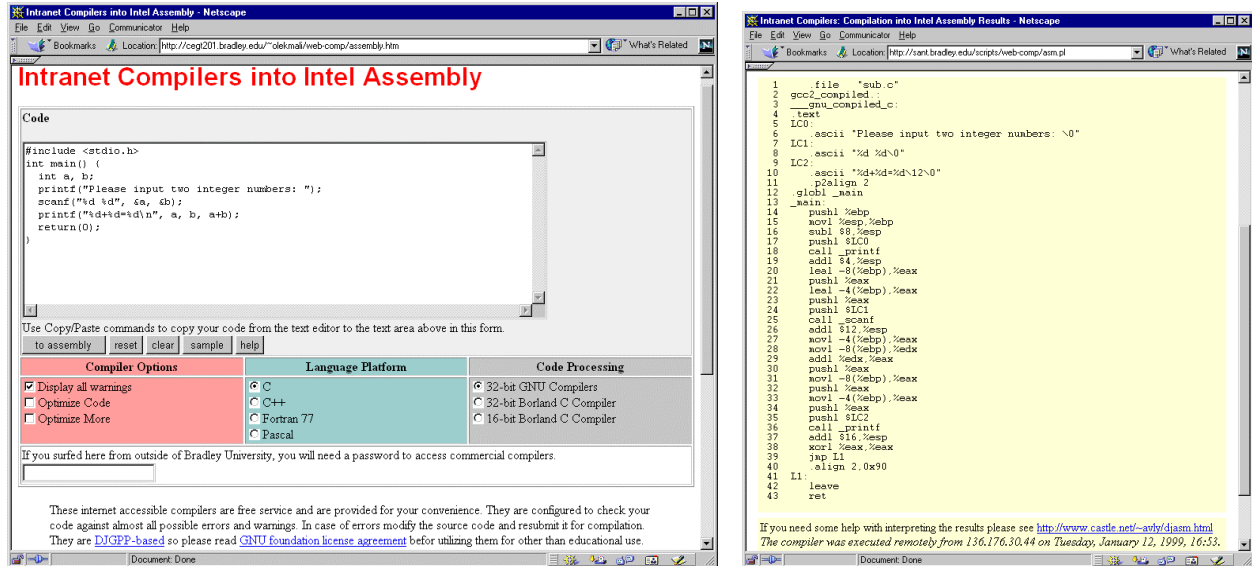

Fig. 4. Specialized front ends for assembly language generator (right) and the result page (left).

Because of additional requirements for displaying Java applets, an additional dedicated front end is created for that language. It is shown in Fig. 3. If the compilation is successful, the user can inspect the applet immediately. Another specialized page was created for the partial compilation into assembly language because users are interested in different set of compiler options that would be useful for generated assembly language code inspection. 16- and 32-bit Intel assembly languages are available. However, a cross-compiler may be used to produce assembly language code for different machines. The assembly front-end and the result page are shown in Fig. 4.
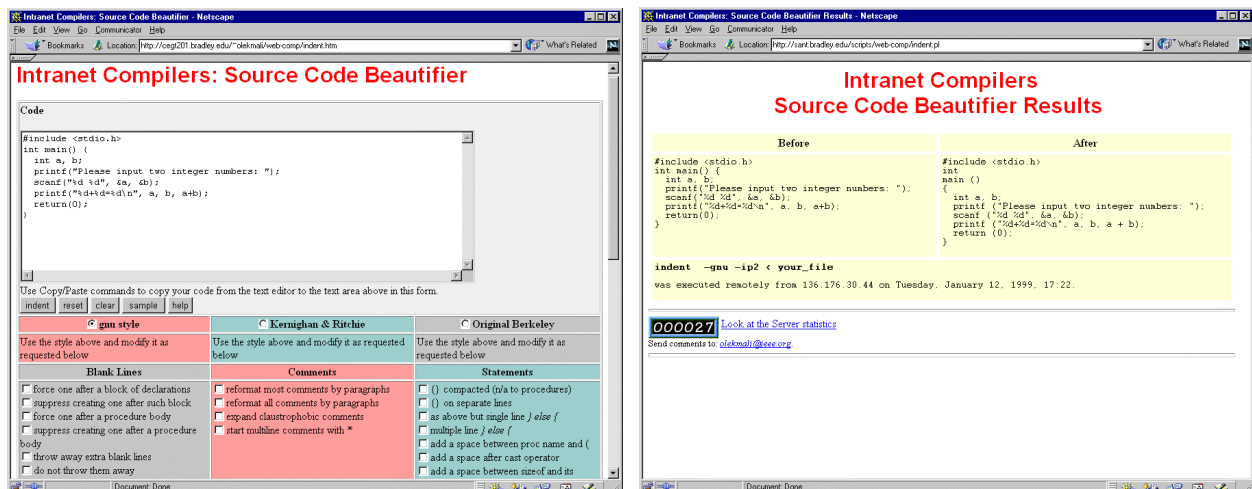

Fig. 5. Source code beautifier configuration page (left) and result page (right).

Another service available at ICP is automatic code formatting performed according to the user's specification. Most of the options are self-descriptive and available with a single click of the mouse allowing even a beginner to use the program. Fig. 5 shows the front end and the result

page. The source code formatting capability is very useful in the first programming course, when beginner programmers try to experiment what coding style fits them the best. It also quite useful in case of parentheses mismatches errors. Missing parentheses can be more easily detected by the automatic indentation inspection especially in programs with many nested loops.

Everybody can inspect and utilize the Intranet Compilers Package by visiting the web site located at http://sant.bradley.edu/web-comp/. When one wants to use ICP over the Internet, only the limited version of the package is accessible. For obvious reasons, everybody can access only the compilers that do not require a license. Commercial compilers (Borland and Microsoft) are accessible only in the Intranet environment for users with selected IP addresses for which the license is bought.

Conclusion

The paper shows how to use the new opportunity created by Internet technologies for the efficient and platform independent usage of software engineering tools. The presented ICP are just an example, but it shows a way in which the technology can be implemented. The possibility to compare error messages from different compilers is very useful especially for students who do not have much experience in coding and debugging yet. The ability to use different compilers allows a programmer to pick up the fastest or the most convenient tool to compile the code and remove the errors. It also offers an easy way to analyze the results of compilation by inspection of generated assembly code. Since August 1988, when the compiler was installed at Bradley University, it was used about 17,000 times, approximately half of that were on-campus students. The up to-date complete usage statistics can be requested any time via Web using the following link: http://sant.bradley.edu/scripts/web-comp/log.pl

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