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.

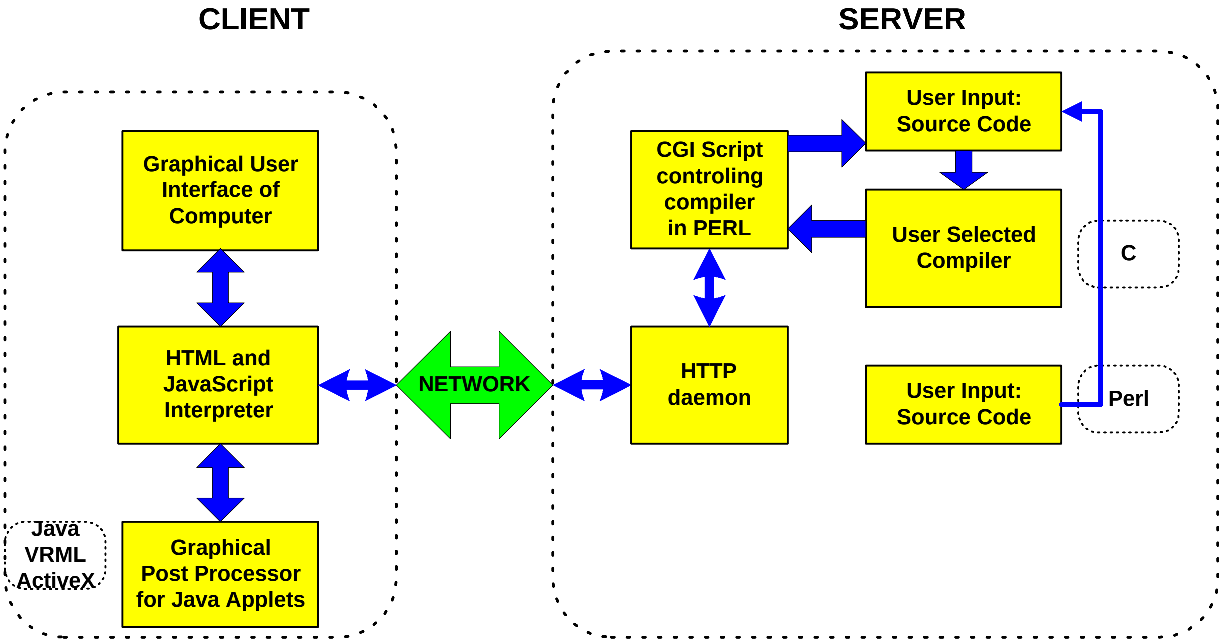
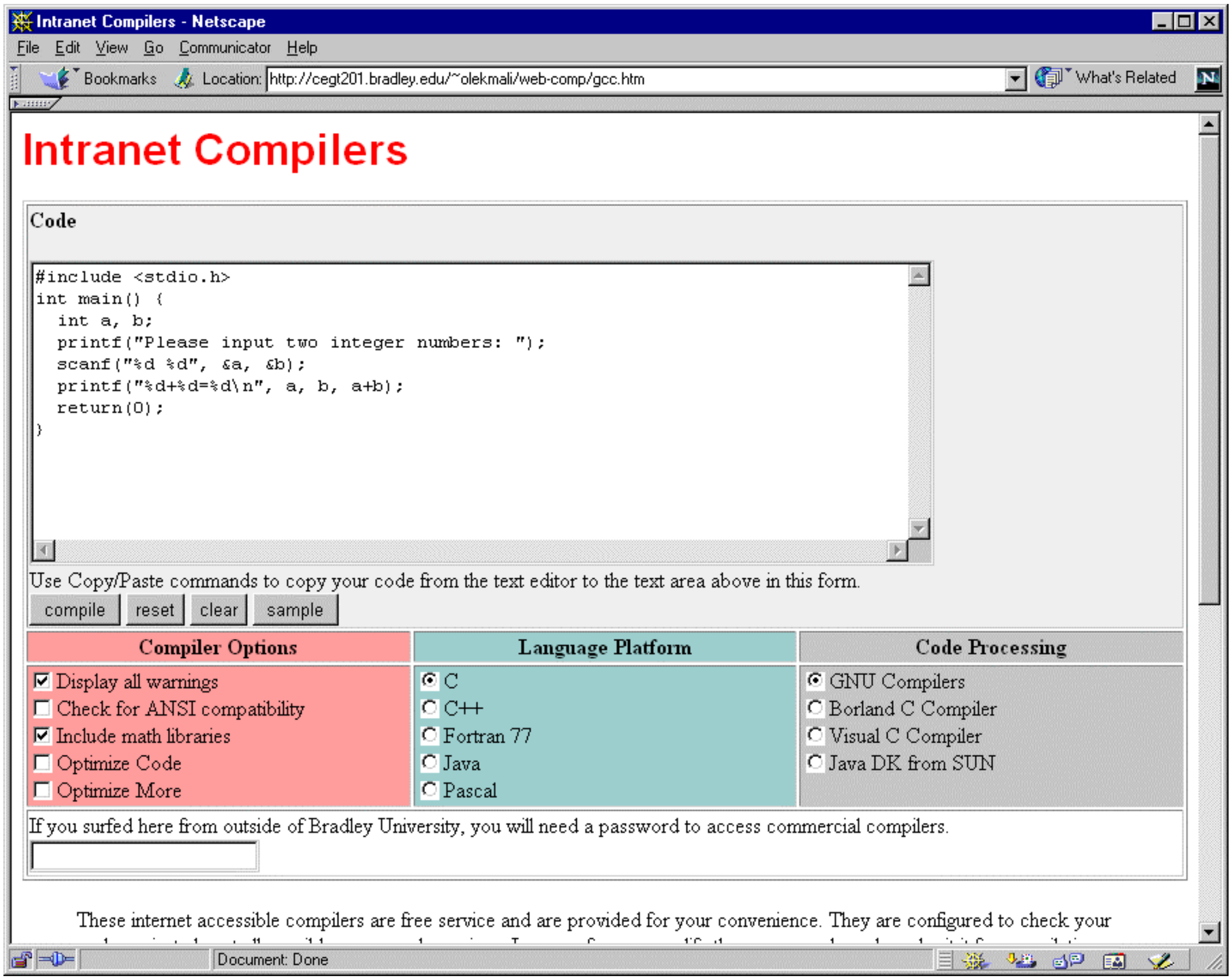

CLIENT
SERVER
Graphical User Interface of Computer
HTML and JavaScript Interpreter
Graphical Post Processor for Java Applets
Java
VRML
ActiveX
NETWORK
CGI Script controling compiler in PERL
User Input: Source Code
User Selected Compiler
C
HTTP daemon
User Input: Source Code
Perl

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.



Location: http://cegt201.bradley.edu/~olekmali/web-comp/gcc.htm

Intranet Compilers

Code

```
#include <stdio.h>
int main() {
  int a, b;
  printf("Please input two integer numbers: ");
  scanf("%d %d", &a, &b);
  printf("%d+%d=%d\n", a, b, a+b);
  return(0);
}
```

Use Copy/Paste commands to copy your code from the text editor to the text area above in this form.

Compiler Options	Language Platform	Code Processing
☑ Display all warnings	● C	● GNU Compilers
☐ Check for ANSI compatibility	○ C++	○ Borland C Compiler
☑ Include math libraries	○ Fortran 77	○ Visual C Compiler
☐ Optimize Code	○ Java	○ Java DK from SUN
☐ Optimize More	○ Pascal	

If you surfed here from outside of Bradley University, you will need a password to access commercial compilers.

These internet accessible compilers are free service and are provided for your convenience. They are configured to check your

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

Intranet Compilers User Interface

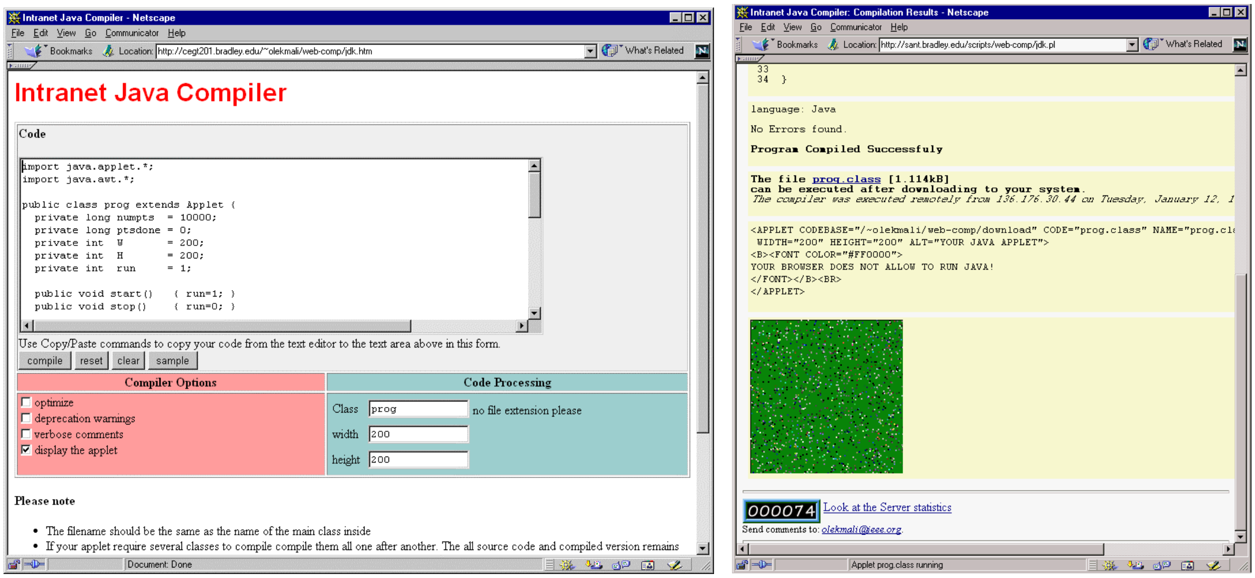
A common front end is used for all compilers, and is presented in Fig. 2. This HTML page allows for selecting a vendor and a language, and for setting a few basic compilation options. User uses copy and paste commands to enter the source code into the compiler front end. There are three menus located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


Intranet Java Compiler - Netscape
File Edit View Go Communicator Help
Bookmarks
Location: http://cegt201.bradley.edu/~olekmali/web-comp/jdk.htm
What's Related

Intranet Java Compiler

Code

```
import java.applet.*;
import java.awt.*;

public class prog extends Applet {
  private long numpts  = 10000;
  private long ptsdone = 0;
  private int  W       = 200;
  private int  H       = 200;
  private int  run     = 1;

  public void start()   { run=1; }
  public void stop()    { run=0; }
```

Use Copy/Paste commands to copy your code from the text editor to the text area above in this form.

compile
reset
clear
sample

Compiler Options	Code Processing
☐ optimize ☐ deprecation warnings ☐ verbose comments ☑ display the applet	Class: prog no file extension please width: 200 height: 200

Please note

- The filename should be the same as the name of the main class inside
- If your applet require several classes to compile compile them all one after another. The all source code and compiled version remains

Document: Done

Intranet Java Compiler: Compilation Results - Netscape
File Edit View Go Communicator Help
Bookmarks
Location: http://sant.bradley.edu/scripts/web-comp/jdk.pl
What's Related

```
 33
 34  }

language: Java

No Errors found.

Program Compiled Successfuly

The file prog.class [1.114kB]
can be executed after downloading to your system.
The compiler was executed remotely from 136.176.30.44 on Tuesday, January 12, 1

<APPLET CODEBASE="/~olekmali/web-comp/download" CODE="prog.class" NAME="prog.cla
 WIDTH="200" HEIGHT="200" ALT="YOUR JAVA APPLET">
<B><FONT COLOR="#FF0000">
YOUR BROWSER DOES NOT ALLOW TO RUN JAVA!
</FONT></B><BR>
</APPLET>
```

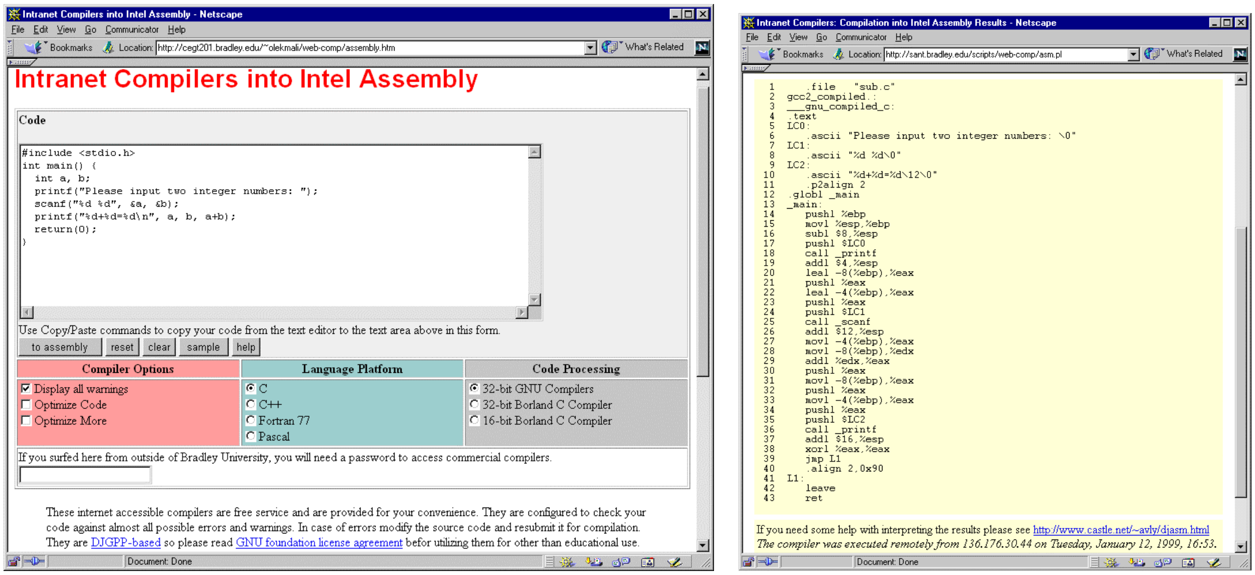
000074 Look at the Server statistics

Send comments to: olekmali@ieee.org.

Applet prog.class running

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.


Intranet Compilers into Intel Assembly - Netscape
File Edit View Go Communicator Help
Bookmarks
Location: http://cegt201.bradley.edu/~olekmali/web-comp/assembly.htm
What's Related
Document: Done

Intranet Compilers into Intel Assembly

Code

```
#include <stdio.h>
int main() {
  int a, b;
  printf("Please input two integer numbers: ");
  scanf("%d %d", &a, &b);
  printf("%d+%d=%d\n", a, b, a+b);
  return(0);
}
```

Use Copy/Paste commands to copy your code from the text editor to the text area above in this form.

to assembly
reset
clear
sample
help

Compiler Options	Language Platform	Code Processing
☑ Display all warnings ☐ Optimize Code ☐ Optimize More	● C ○ C++ ○ Fortran 77 ○ Pascal	● 32-bit GNU Compilers ○ 32-bit Borland C Compiler ○ 16-bit Borland C Compiler

If you surfed here from outside of Bradley University, you will need a password to access commercial compilers.

These internet accessible compilers are free service and are provided for your convenience. They are configured to check your code against almost all possible errors and warnings. In case of errors modify the source code and resubmit it for compilation. They are DJGPP-based so please read GNU foundation license agreement befor utilizing them for other than educational use.

Intranet Compilers: Compilation into Intel Assembly Results - Netscape
File Edit View Go Communicator Help
Bookmarks
Location: http://sant.bradley.edu/scripts/web-comp/asm.pl
What's Related
Document: Done

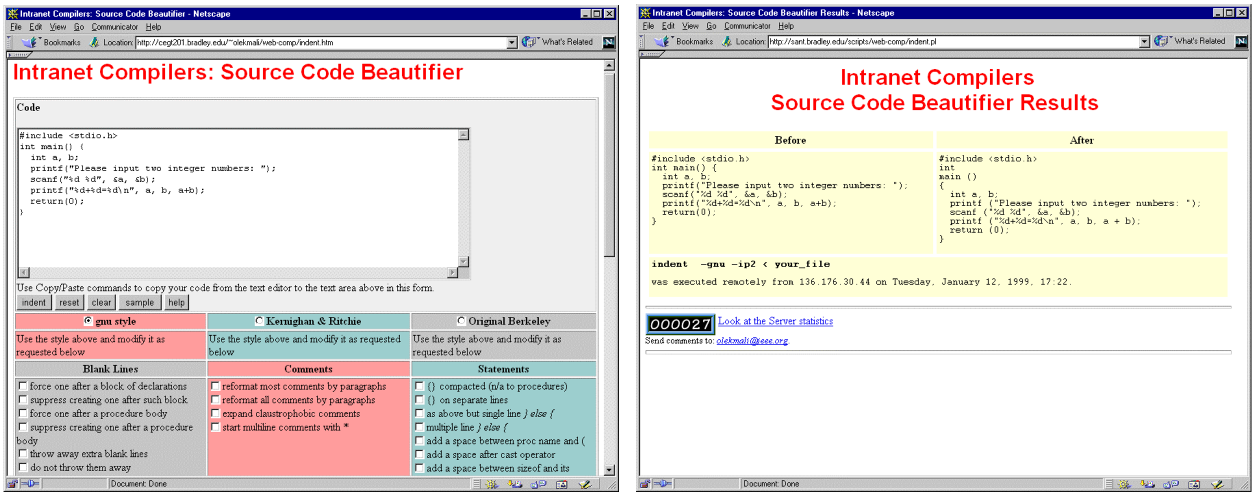
```
    .file   "sub.c"
gcc2_compiled.:
___gnu_compiled_c:
.text
LC0:
    .ascii "Please input two integer numbers: \0"
LC1:
    .ascii "%d %d\0"
LC2:
    .ascii "%d+%d=%d\12\0"
    .p2align 2
.globl _main
_main:
    pushl %ebp
    movl %esp,%ebp
    subl $8,%esp
    pushl $LC0
    call _printf
    addl $4,%esp
    leal -8(%ebp),%eax
    pushl %eax
    leal -4(%ebp),%eax
    pushl %eax
    pushl $LC1
    call _scanf
    addl $12,%esp
    movl -4(%ebp),%eax
    movl -8(%ebp),%edx
    addl %edx,%eax
    pushl %eax
    movl -8(%ebp),%eax
    pushl %eax
    movl -4(%ebp),%eax
    pushl %eax
    pushl $LC2
    call _printf
    addl $16,%esp
    xorl %eax,%eax
    jmp L1
    .align 2,0x90
L1:
    leave
    ret
```

If you need some help with interpreting the results please see http://www.castle.net/~avly/djasm.html

The compiler was executed remotely from 136.176.30.44 on Tuesday, January 12, 1999, 16:53.

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.


Intranet Compilers: Source Code Beautifier - Netscape
File Edit View Go Communicator Help
Bookmarks
Location: http://cegt201.bradley.edu/~olekmali/web-comp/indent.htm
What's Related
Document: Done

Intranet Compilers: Source Code Beautifier

Code

```
#include <stdio.h>
int main() {
  int a, b;
  printf("Please input two integer numbers: ");
  scanf("%d %d", &a, &b);
  printf("%d+%d=%d\n", a, b, a+b);
  return(0);
}
```

Use Copy/Paste commands to copy your code from the text editor to the text area above in this form.

indent
reset
clear
sample
help

● gnu style	○ Kernighan & Ritchie	○ Original Berkeley
Use the style above and modify it as requested below	Use the style above and modify it as requested below	Use the style above and modify it as requested below
Blank Lines	**Comments**	**Statements**
☐ force one after a block of declarations ☐ suppress creating one after such block ☐ force one after a procedure body ☐ suppress creating one after a procedure body ☐ throw away extra blank lines ☐ do not throw them away	☐ reformat most comments by paragraphs ☐ reformat all comments by paragraphs ☐ expand claustrophobic comments ☐ start multiline comments with *	☐ {} compacted (n/a to procedures) ☐ {} on separate lines ☐ as above but single line *} else {* ☐ multiple line *} else {* ☐ add a space between proc name and (☐ add a space after cast operator ☐ add a space between sizeof and its

Intranet Compilers: Source Code Beautifier Results - Netscape
File Edit View Go Communicator Help
Bookmarks
Location: http://sant.bradley.edu/scripts/web-comp/indent.pl
What's Related
Document: Done

Intranet Compilers
Source Code Beautifier Results

Before	After

`#include <stdio.h>`
`int main() {`
`  int a, b;`
`  printf("Please input two integer numbers: ");`
`  scanf("%d %d", &a, &b);`
`  printf("%d+%d=%d\n", a, b, a+b);`
`  return(0);`
`}`
	`#include <stdio.h>`
	`int`
	`main ()`
	`{`
	`  int a, b;`
	`  printf ("Please input two integer numbers: ");`
	`  scanf ("%d %d", &a, &b);`
	`  printf ("%d+%d=%d\n", a, b, a + b);`
	`  return (0);`
	`}`

```
indent  -gnu -ip2 < your_file

was executed remotely from 136.176.30.44 on Tuesday, January 12, 1999, 17:22.
```

000027 Look at the Server statistics

Send comments to: *olekmali@ieee.org*.

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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Aleksander Malinowski is an Assistant Professor at the Electrical and Computer Engineering Department of the Bradley University. He is also an associate editor of the IEEE Industrial Electronics Society Newsletter. He received his MS in electronics in 1989 from the Technical University of Gdansk, Poland and Ph.D. in computer science and engineering in 1996 from the University of Louisville, KY. Dr. Malinowski is the author of 4 journal papers and 31 other refereed publications. The areas of his main interests are Web programming, network computing, computer simulation and modeling, computational intelligence and computer architecture.

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