程序设计基础及语言(I)

实验指导手册

东南大学

计算机科学与工程学院

软件学院

2011 年 9 月

目　　录

第一部分 实验环境的使用方法

Visual C++ 2005（简称 VC++）是 Microsoft 公司开发的基于 C/C++的集成开发工具，它是 Visual Studio 中功能强大、代码效率最高的开发工具。

利用 Visual C++可以采用两种方式编写 Win32 应用程序：

第一种：基于 Windows API 的编程方式（又称为控制台编程方式）。

第二种：基于 MFC 的 C++编程方式。

本节介绍 VC++语言的最基本的编程环境和控制台编程方式，通过简单实例介绍 VC++的基本使用方法，使学生尽快学会和掌握如何在 VC++环境下，采用控制台编程方式进行课程实验。

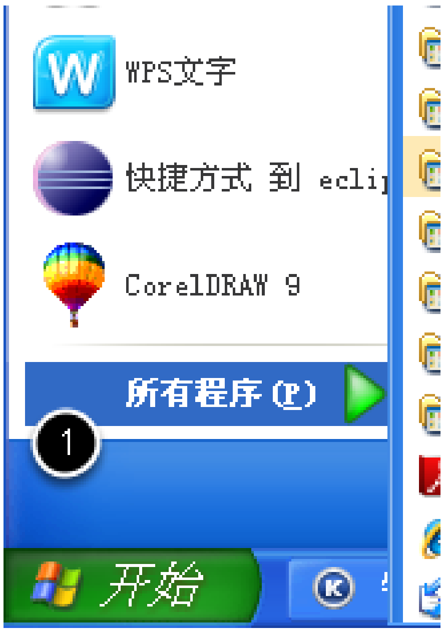
1.1 目的

1. 了解 Visual C++ 2005 的特点。
2. 熟悉 Visual C++ 2005 的控制台开发环境。
3. 学习和掌握 Visual C++ 2005 的编写控制台程序的方法

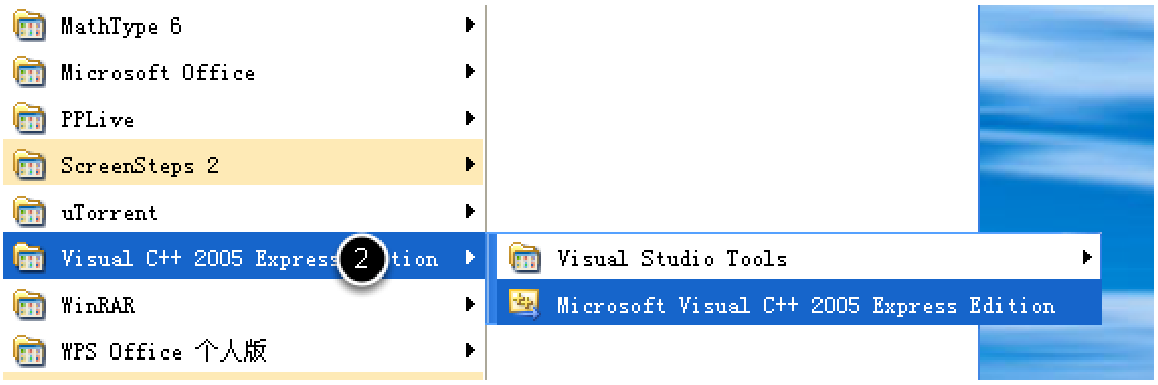
1.2 Visual C++2005 Express Edition Manual

Created with a trial version of ScreenSteps

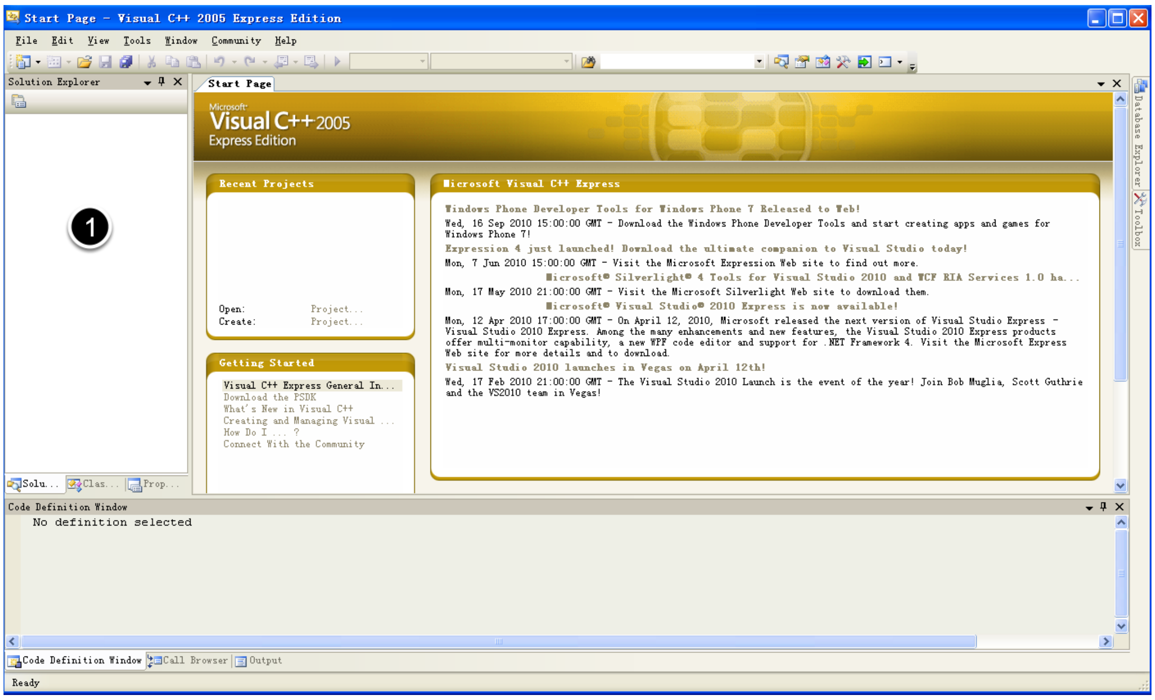
1.2.1 First Run



点击 windows 左下角，开始 - 程序， 找到新安装的 Microsoft Visual Studio 2005 Express。



点击第二个图标选项，就可以启动 Visual C++ 2005Express。



Microsoft Visual C++ Express

Windows Phone Developer Tools for Windows Phone 7 Released to Web!
Wed, 16 Sep 2010 15:00:00 GMT - Download the Windows Phone Developer Tools and start creating apps and games for Windows Phone 7!

Expression 4 just launched! Download the ultimate companion to Visual Studio today!
Mon, 7 Jun 2010 15:00:00 GMT - Visit the Microsoft Expression Web site to find out more.

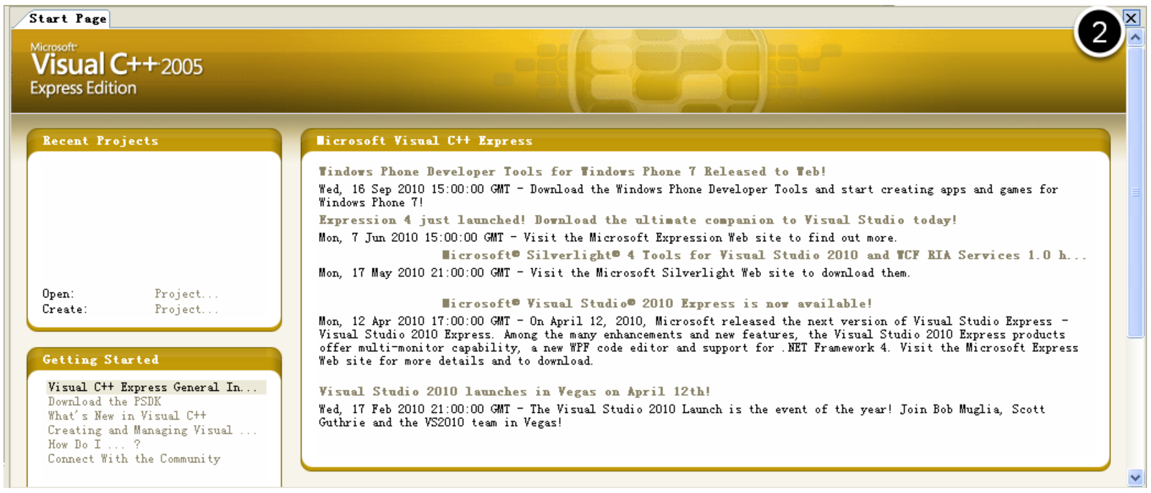
Microsoft® Silverlight® 4 Tools for Visual Studio 2010 and WCF RIA Services 1.0 ha...
Mon, 17 May 2010 21:00:00 GMT - Visit the Microsoft Silverlight Web site to download them.

Microsoft® Visual Studio® 2010 Express is now available!
Mon, 12 Apr 2010 17:00:00 GMT - On April 12, 2010, Microsoft released the next version of Visual Studio Express - Visual Studio 2010 Express. Among the many enhancements and new features, the Visual Studio 2010 Express products offer multi-monitor capability, a new WPF code editor and support for .NET Framework 4. Visit the Microsoft Express Web site for more details and to download.

Visual Studio 2010 launches in Vegas on April 12th!
Wed, 17 Feb 2010 21:00:00 GMT - The Visual Studio 2010 Launch is the event of the year! Join Bob Muglia, Scott Guthrie and the VS2010 team in Vegas!

No definition selected

顺利的话，会看到这样的界面，如果没有看见，一定是安装过程出问题了。


Start Page
Microsoft Visual C++ 2005 Express Edition
2
Recent Projects
Open: Project...
Create: Project...
Getting Started
Visual C++ Express General In...
Download the PSDK
What's New in Visual C++
Creating and Managing Visual ...
How Do I ... ?
Connect With the Community
Microsoft Visual C++ Express

Windows Phone Developer Tools for Windows Phone 7 Released to Web!

Wed, 16 Sep 2010 15:00:00 GMT - Download the Windows Phone Developer Tools and start creating apps and games for Windows Phone 7!

Expression 4 just launched! Download the ultimate companion to Visual Studio today!

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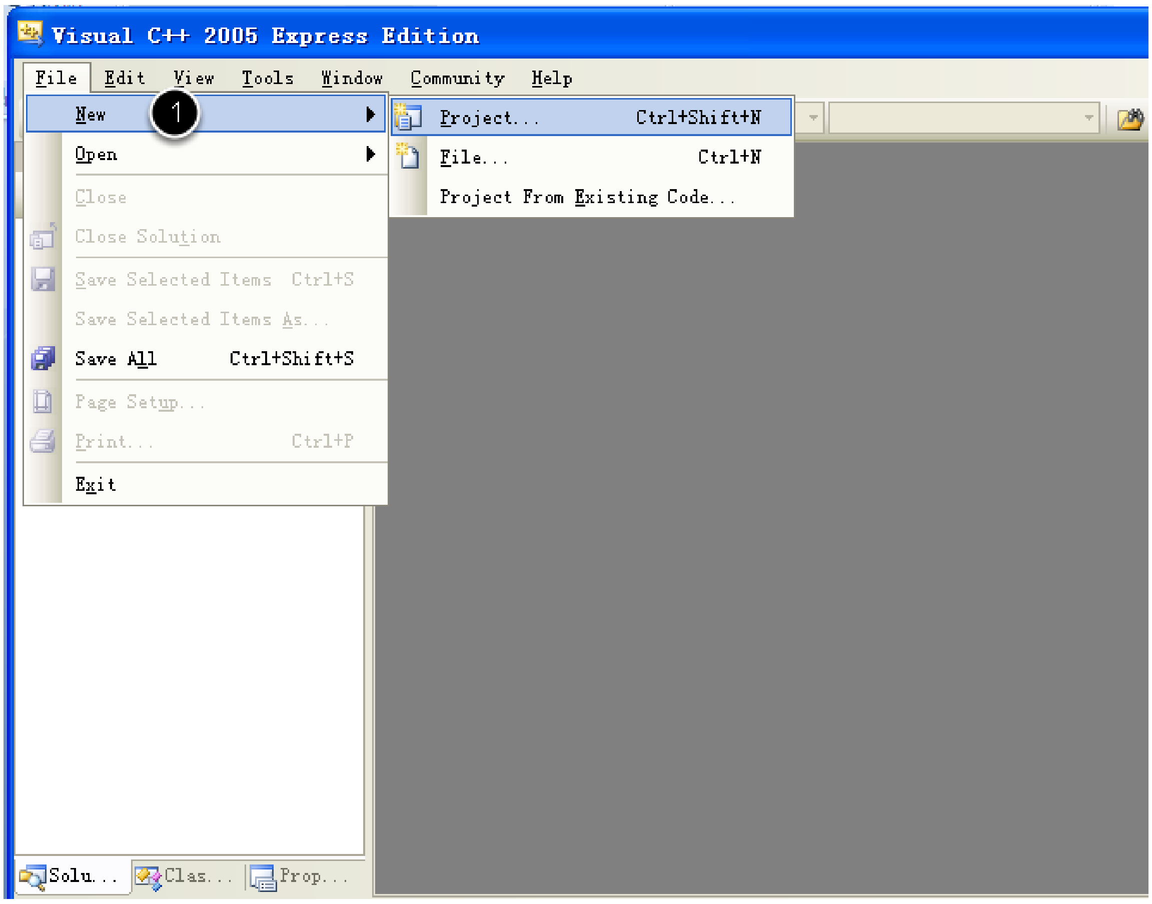
Visual Studio 2010 launches in Vegas on April 12th!

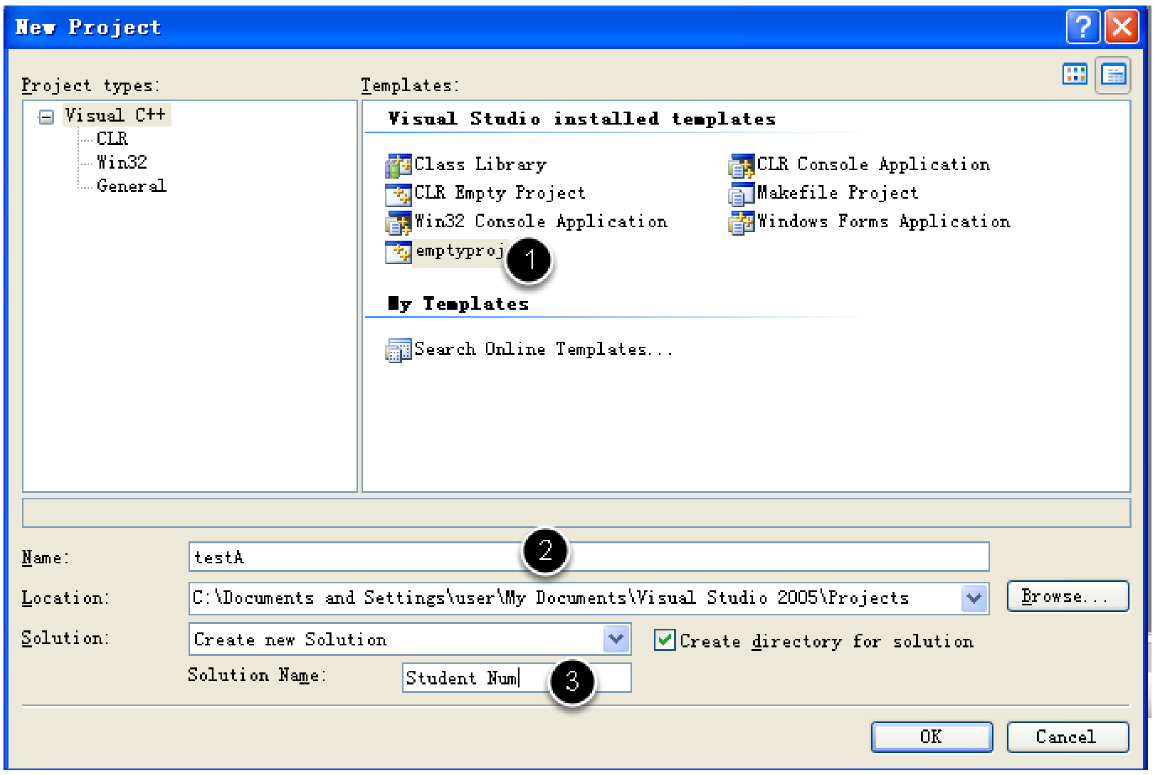
Wed, 17 Feb 2010 21:00:00 GMT - The Visual Studio 2010 Launch is the event of the year! Join Bob Muglia, Scott Guthrie and the VS2010 team in Vegas!

点击右上角小叉，将小窗口关闭。

1.2.2 New project


Visual C++ 2005 Express Edition
File Edit View Tools Window Community Help
New
1
Open
Close
Close Solution
Save Selected Items Ctrl+S
Save Selected Items As...
Save All Ctrl+Shift+S
Page Setup...
Print... Ctrl+P
Exit
Project... Ctrl+Shift+N
File... Ctrl+N
Project From Existing Code...
Solu...
Clas...
Prop...

点击左上角，New Project，新建项目。



Name: testA

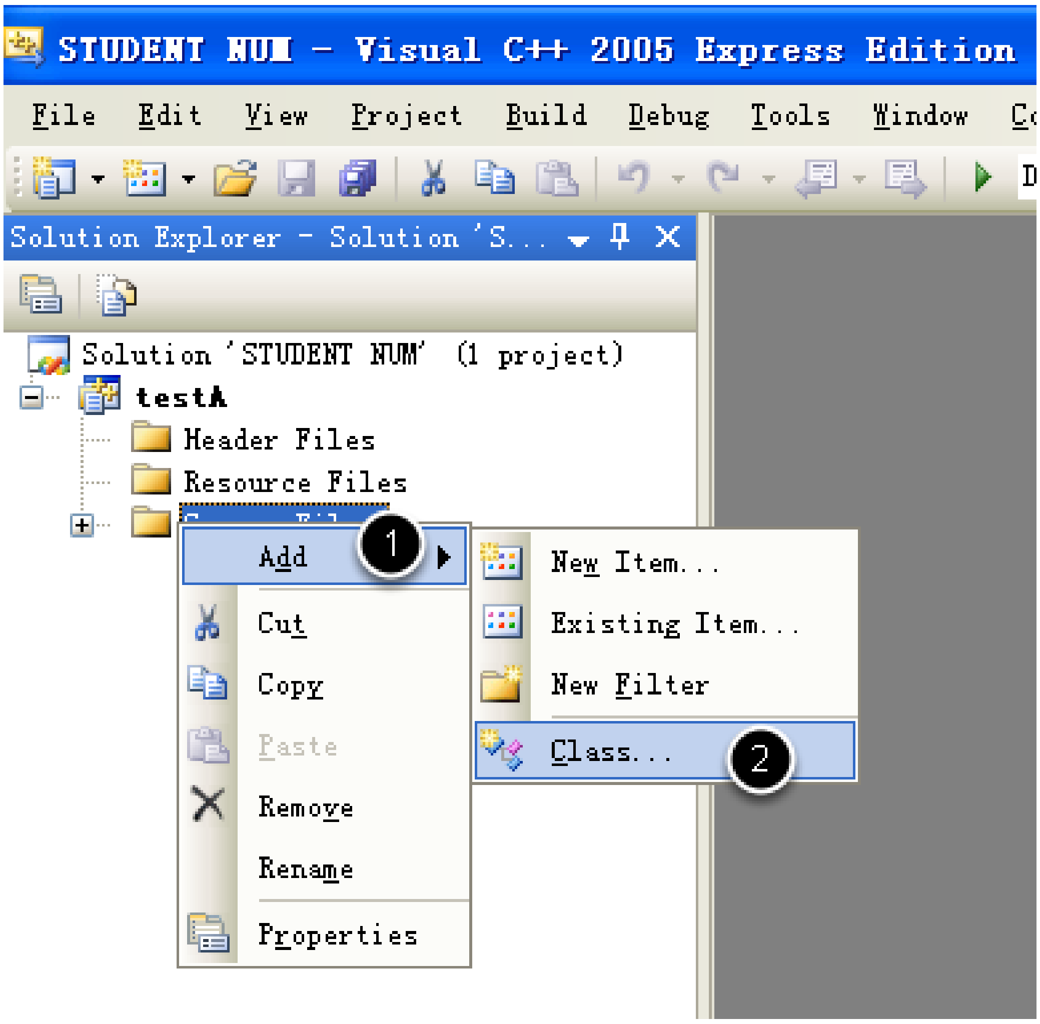
Location: C:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects

Solution: Create new Solution

✓ Create directory for solution

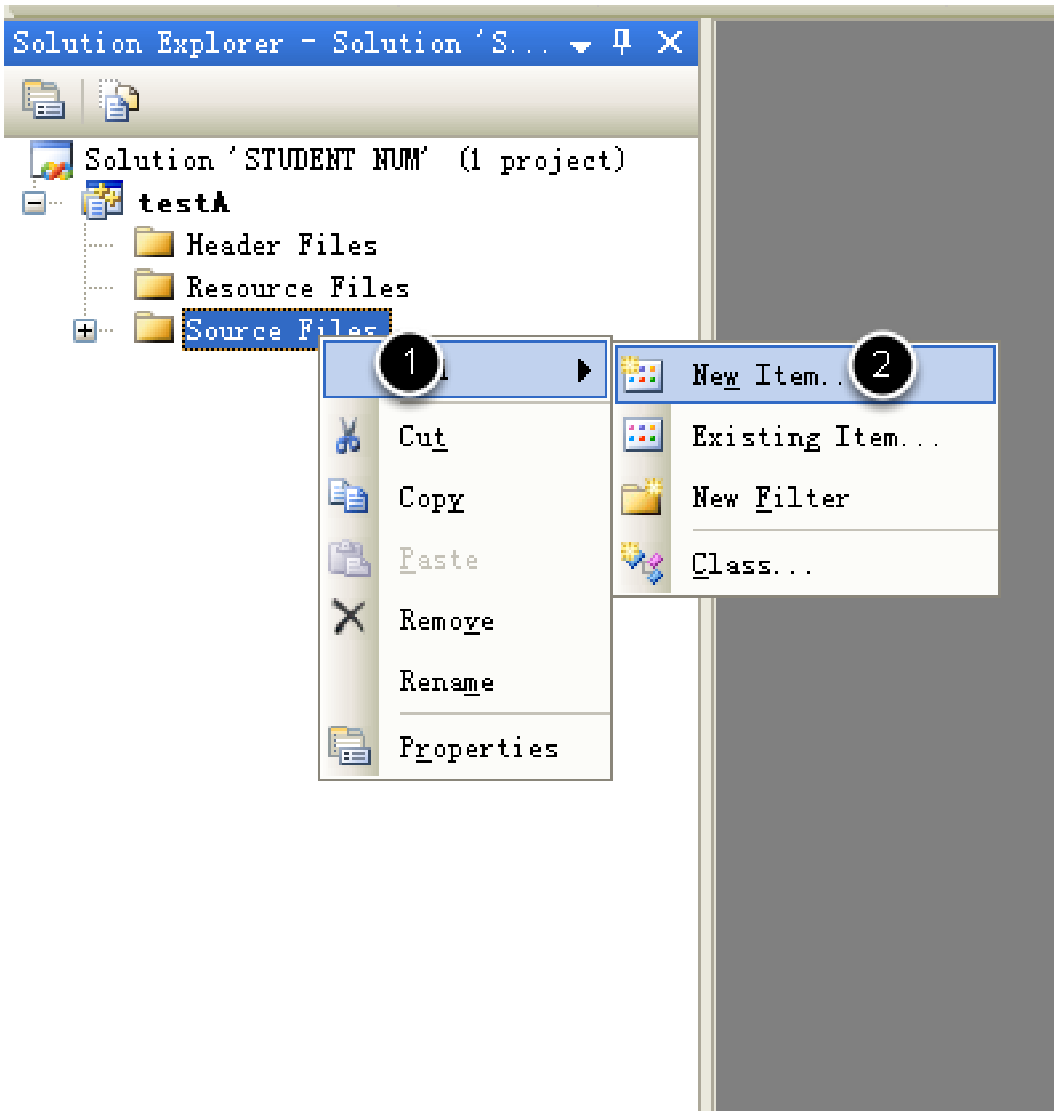
Solution Name: Student Num

选择 emptyproj。

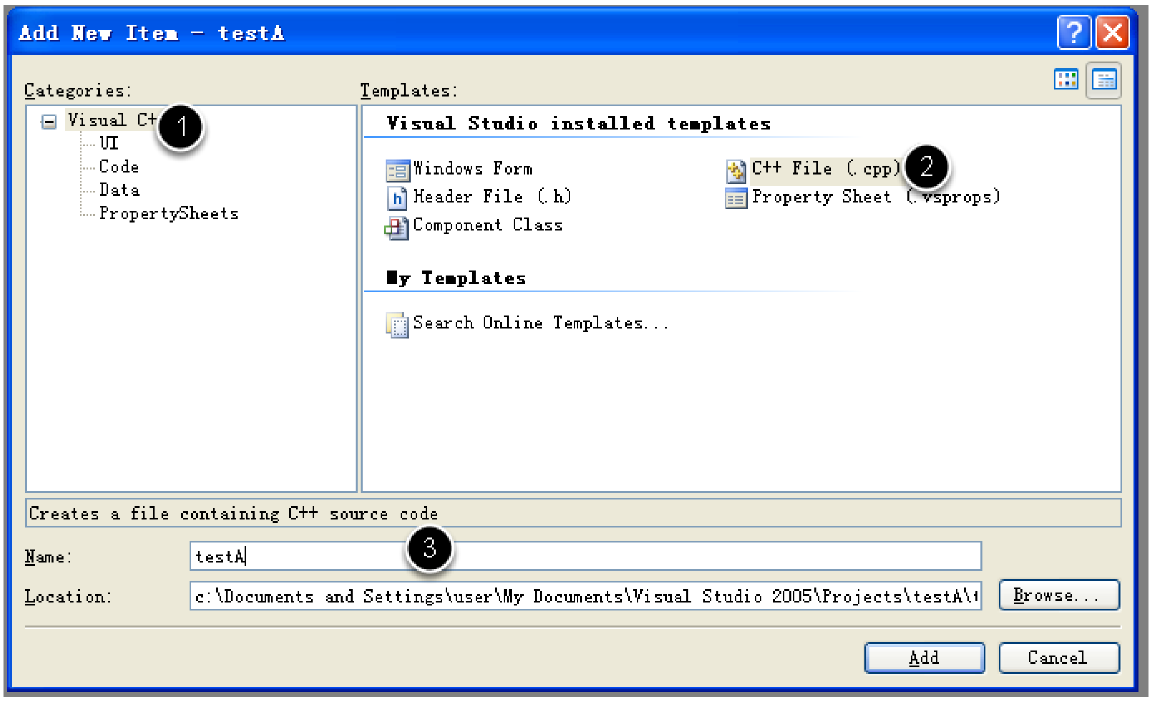


鼠标右击 Source File->Add->Class

1.2.3 Add new source file



或者 Source File->Add->New Item 这两种方法都可以用来添加新项目。这里选择新建项。

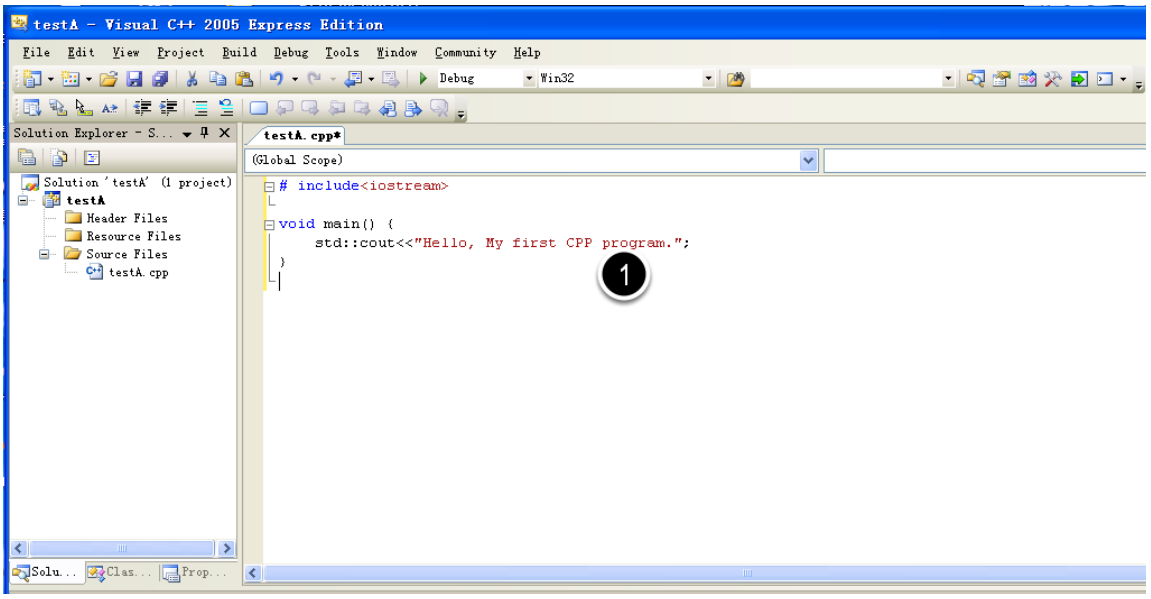


Creates a file containing C++ source code

Name: testA

Location: c:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\testA\t

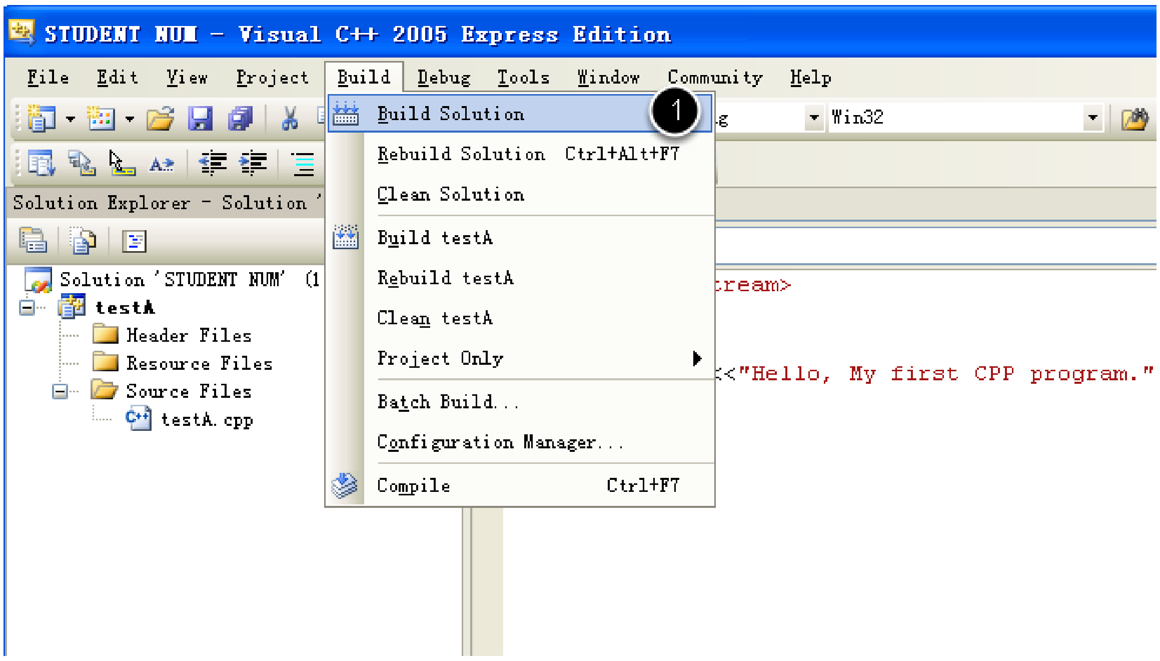
弹出此窗口后，选择 C++File，新建一个 cpp 文件，名为 testA，最后选择 Add。



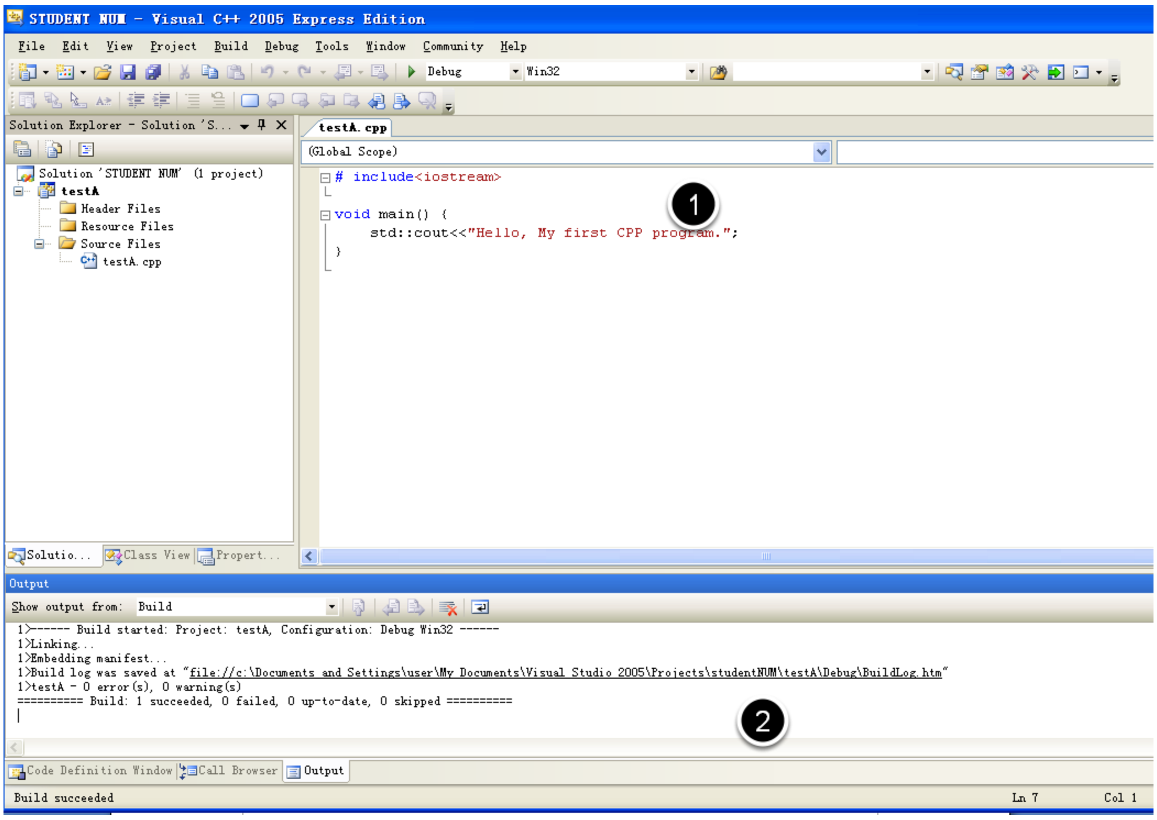
```
# include<iostream>

void main() {
    std::cout<<"Hello, My first CPP program.";
}
```

在这个界面里，就可以编辑 testA.cpp 这个文件了。
填写：

```
# include<iostream>

void main() {
    std::cout<<"Hello, My first CPP program.";
}
```


STUDENT NUM - Visual C++ 2005 Express Edition
File Edit View Project Build Debug Tools Window Community Help
Build Solution
1
Rebuild Solution Ctrl+Alt+F7
Clean Solution
Build testA
Rebuild testA
Clean testA
Project Only
Batch Build...
Configuration Manager...
Compile Ctrl+F7
Win32
Solution Explorer - Solution
Solution 'STUDENT NUM' (1
testA
Header Files
Resource Files
Source Files
testA.cpp

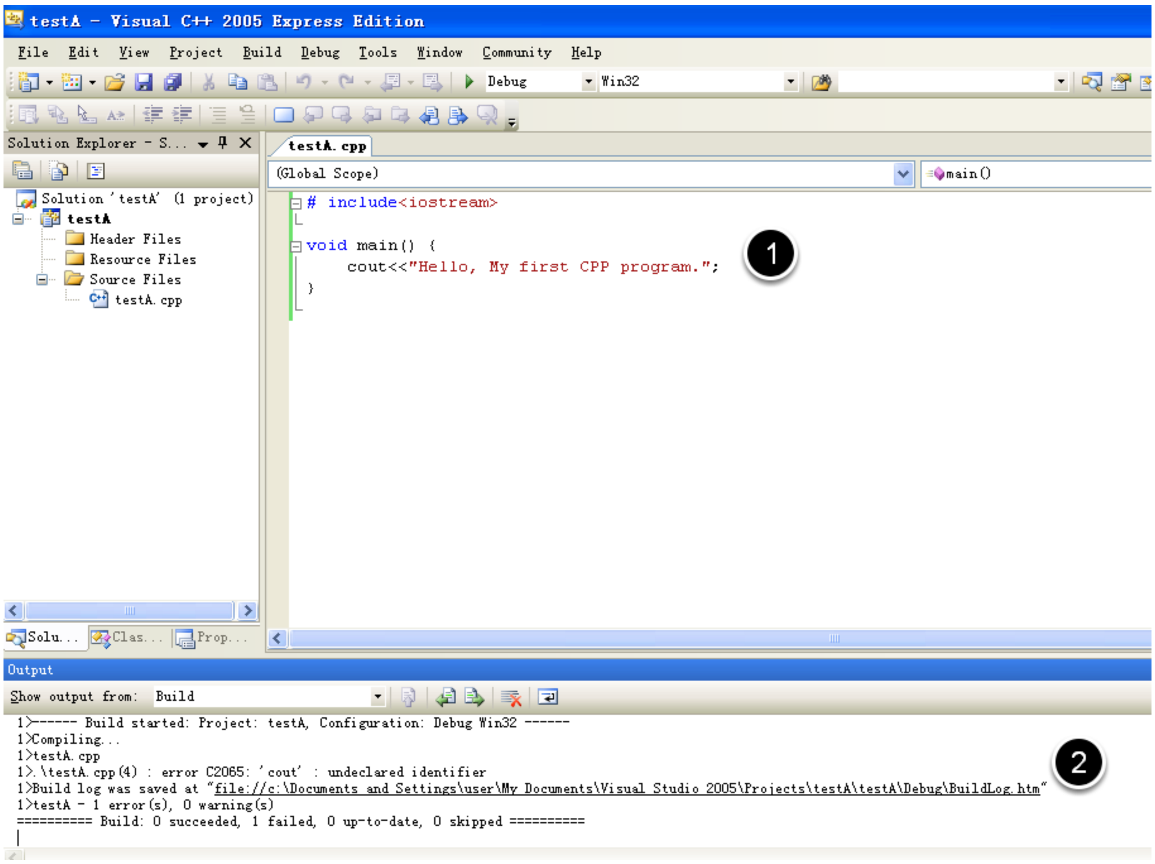
生成解决方案，Build Solution F7。



```
# include<iostream>

void main() {
    std::cout<<"Hello, My first CPP program.";
}
```

```
1>------ Build started: Project: testA, Configuration: Debug Win32 ------
1>Linking...
1>Embedding manifest...
1>Build log was saved at "file://c:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\studentNUM\testA\Debug\BuildLog.htm"
1>testA - 0 error(s), 0 warning(s)
========== Build: 1 succeeded, 0 failed, 0 up-to-date, 0 skipped ==========
```

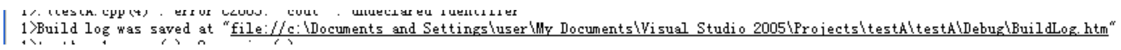
正常就可以看到，编译成功的消息。



```
# include<iostream>

void main() {
    cout<<"Hello, My first CPP program.";
}
```

```
1>------ Build started: Project: testA, Configuration: Debug Win32 ------
1>Compiling...
1>testA.cpp
1>.\testA.cpp(4) : error C2065: 'cout' : undeclared identifier
1>Build log was saved at "file://c:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\testA\testA\Debug\BuildLog.htm"
1>testA - 1 error(s), 0 warning(s)
========== Build: 0 succeeded, 1 failed, 0 up-to-date, 0 skipped ==========
```

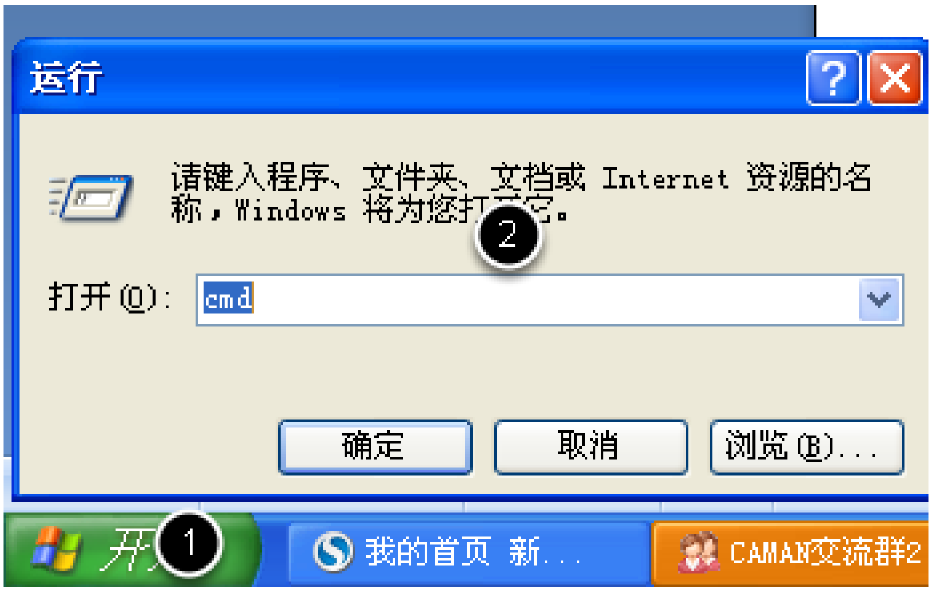
如果说你的源程序有明显的语法错误， 按 F7 编译，则会提示编译失败。



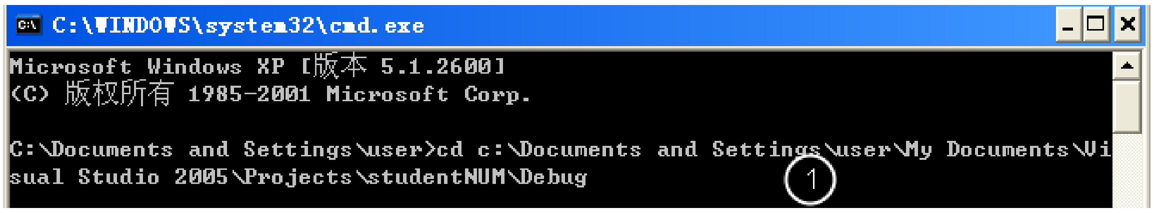
```
1>Build log was saved at "file://c:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\testA\testA\Debug\BuildLog.htm"
```

编译出来的结果放在这里了。这个路径信息很重要。

1.2.4 Run Program in Dos Prompt

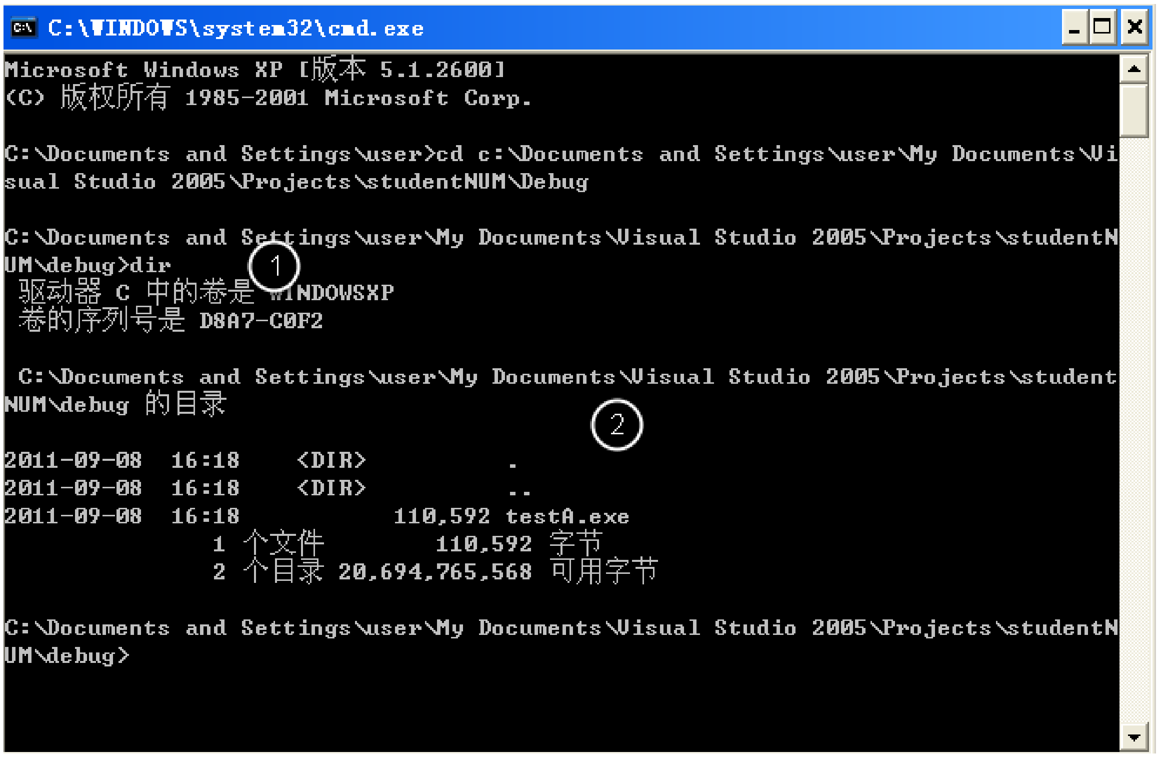

运行
请键入程序、文件夹、文档或 Internet 资源的名称，Windows 将为您打开它。
打开(O): cmd
确定
取消
浏览(B)...
开始
我的首页 新...
CAMAN交流群2
1
2

点击开始->运行->输入 cmd,按回车键。



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [版本 5.1.2600]
(C) 版权所有 1985-2001 Microsoft Corp.

C:\Documents and Settings\user>cd c:\Documents and Settings\user\My Documents\Vi
sual Studio 2005\Projects\studentNUM\Debug
```

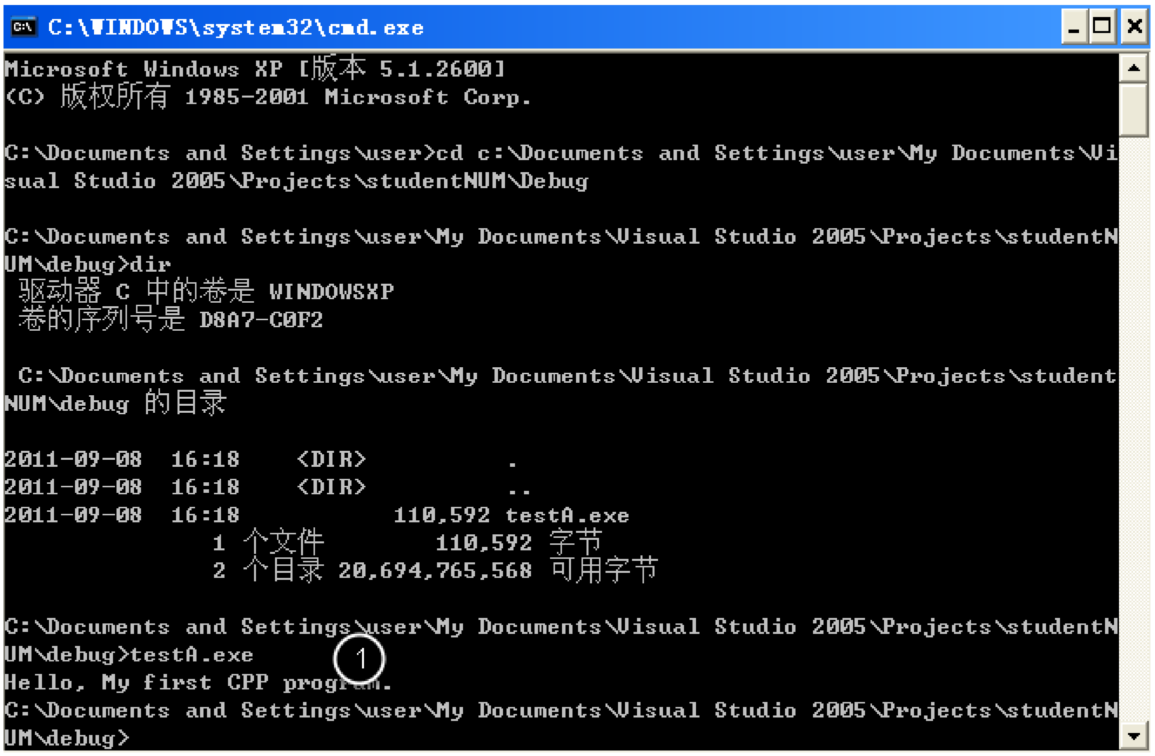
输入以上命令， cd 是更改路径的命令。 当然，可以用复制+粘贴命令，把刚才的路径信息复制下来，如果不会就认真输入。



C:\WINDOWS\system32\cmd.exe

```
Microsoft Windows XP [版本 5.1.2600]
(C) 版权所有 1985-2001 Microsoft Corp.

C:\Documents and Settings\user>cd c:\Documents and Settings\user\My Documents\Vi
sual Studio 2005\Projects\studentNUM\Debug

C:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\studentN
UM\debug>dir
 驱动器 C 中的卷是 WINDOWSXP
 卷的序列号是 D8A7-C0F2

 C:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\student
NUM\debug 的目录

2011-09-08  16:18    <DIR>          .
2011-09-08  16:18    <DIR>          ..
2011-09-08  16:18           110,592 testA.exe
               1 个文件        110,592 字节
               2 个目录 20,694,765,568 可用字节

C:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\studentN
UM\debug>
```

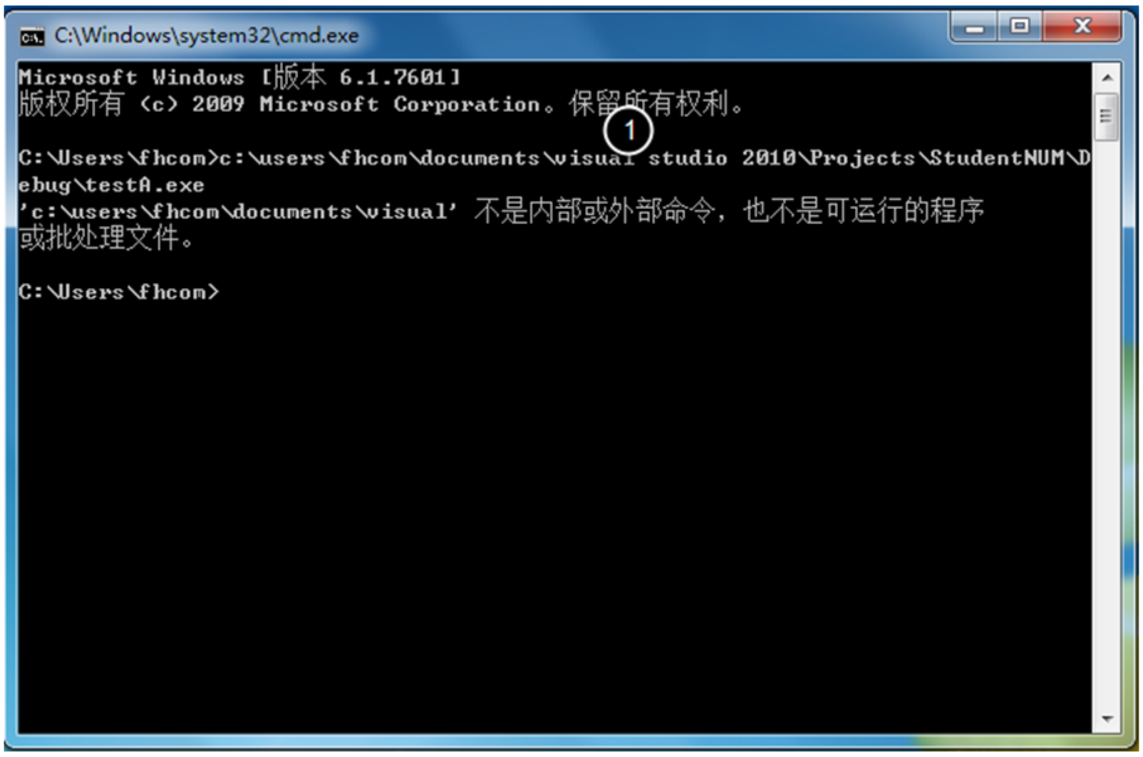
争取变更路径后，用 dir 命令，可以显示当前目录中的文件。 确认刚才编译的结果存在。如果不存在，可能是没有编译成功，或者路径错误。



C:\WINDOWS\system32\cmd.exe

```
Microsoft Windows XP [版本 5.1.2600]
(C) 版权所有 1985-2001 Microsoft Corp.

C:\Documents and Settings\user>cd c:\Documents and Settings\user\My Documents\Vi
sual Studio 2005\Projects\studentNUM\Debug

C:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\studentN
UM\debug>dir
 驱动器 C 中的卷是 WINDOWSXP
 卷的序列号是 D8A7-C0F2

 C:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\student
NUM\debug 的目录

2011-09-08  16:18    <DIR>          .
2011-09-08  16:18    <DIR>          ..
2011-09-08  16:18           110,592 testA.exe
               1 个文件        110,592 字节
               2 个目录 20,694,765,568 可用字节

C:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\studentN
UM\debug>testA.exe
Hello, My first CPP program.
C:\Documents and Settings\user\My Documents\Visual Studio 2005\Projects\studentN
UM\debug>
```

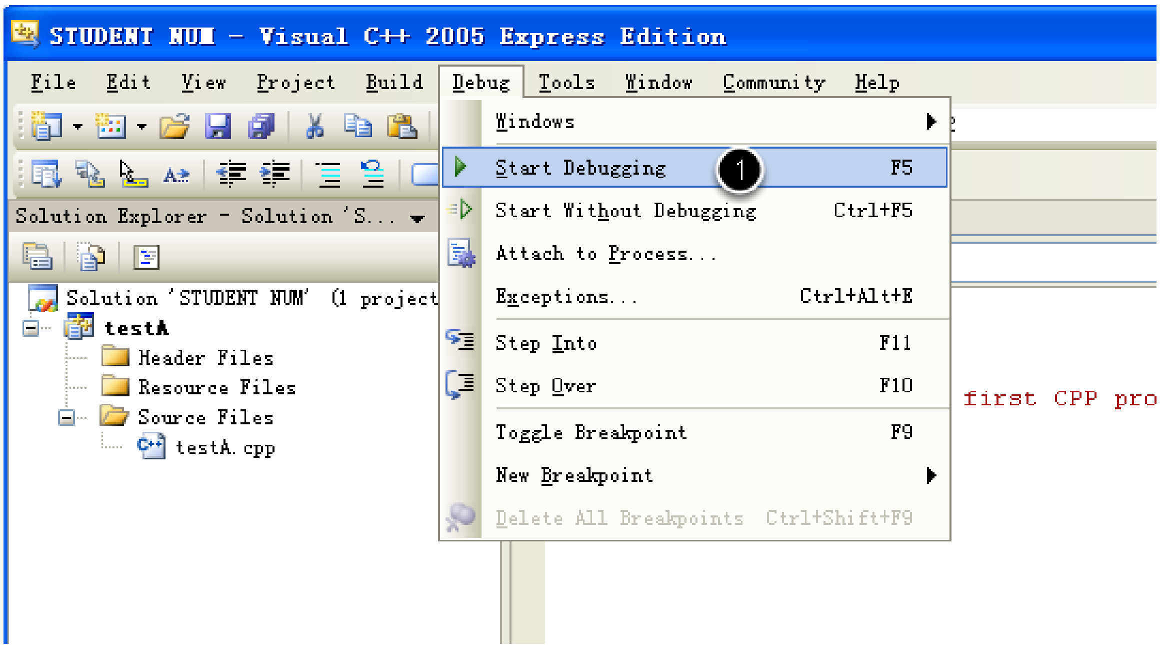
输入 testA.exe ， 回车键执行该程序。 可以看到 Hello 信息，表面程序可以正常的编译执行。



```
Microsoft Windows [版本 6.1.7601]
版权所有 (c) 2009 Microsoft Corporation。保留所有权利。

C:\Users\fhcom>c:\users\fhcom\documents\visual studio 2010\Projects\StudentNUM\D
ebug\testA.exe
'c:\users\fhcom\documents\visual' 不是内部或外部命令，也不是可运行的程序
或批处理文件。

C:\Users\fhcom>
```

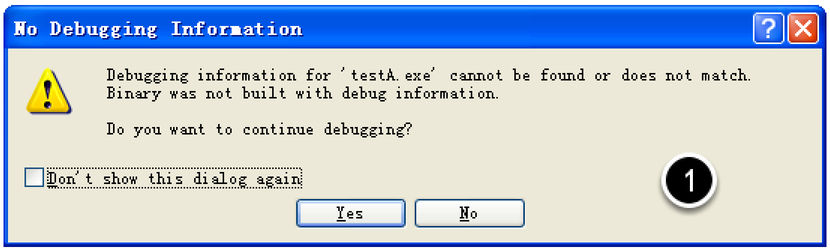
如果想偷懒，在 DOS 窗口下，直接复制路径和执行程序名， 会出现错误。

1.2.5 Run program in IDE



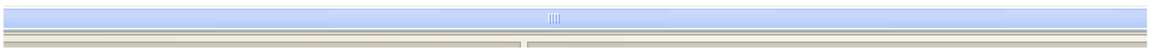
STUDENT NUM - Visual C++ 2005 Express Edition
File Edit View Project Build Debug Tools Window Community Help
Windows
Start Debugging F5
1
Start Without Debugging Ctrl+F5
Attach to Process...
Exceptions... Ctrl+Alt+E
Step Into F11
Step Over F10
Toggle Breakpoint F9
New Breakpoint
Delete All Breakpoints Ctrl+Shift+F9
Solution Explorer - Solution 'S...
Solution 'STUDENT NUM' (1 project
testA
Header Files
Resource Files
Source Files
testA.cpp
first CPP pro

当然，大家也可以用 F5， 利用调试方式去运行一个程序

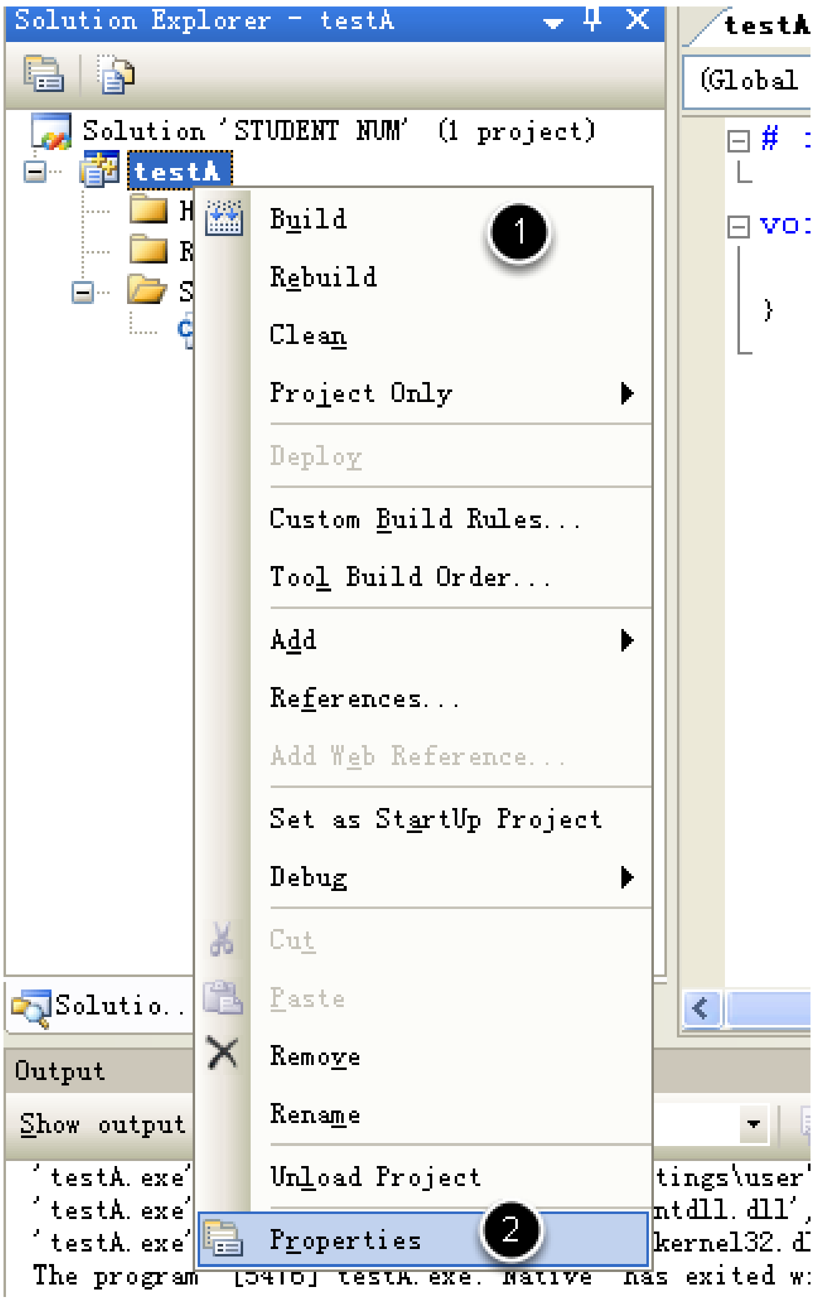

No Debugging Information

Debugging information for 'testA.exe' cannot be found or does not match.
Binary was not built with debug information.

Do you want to continue debugging?

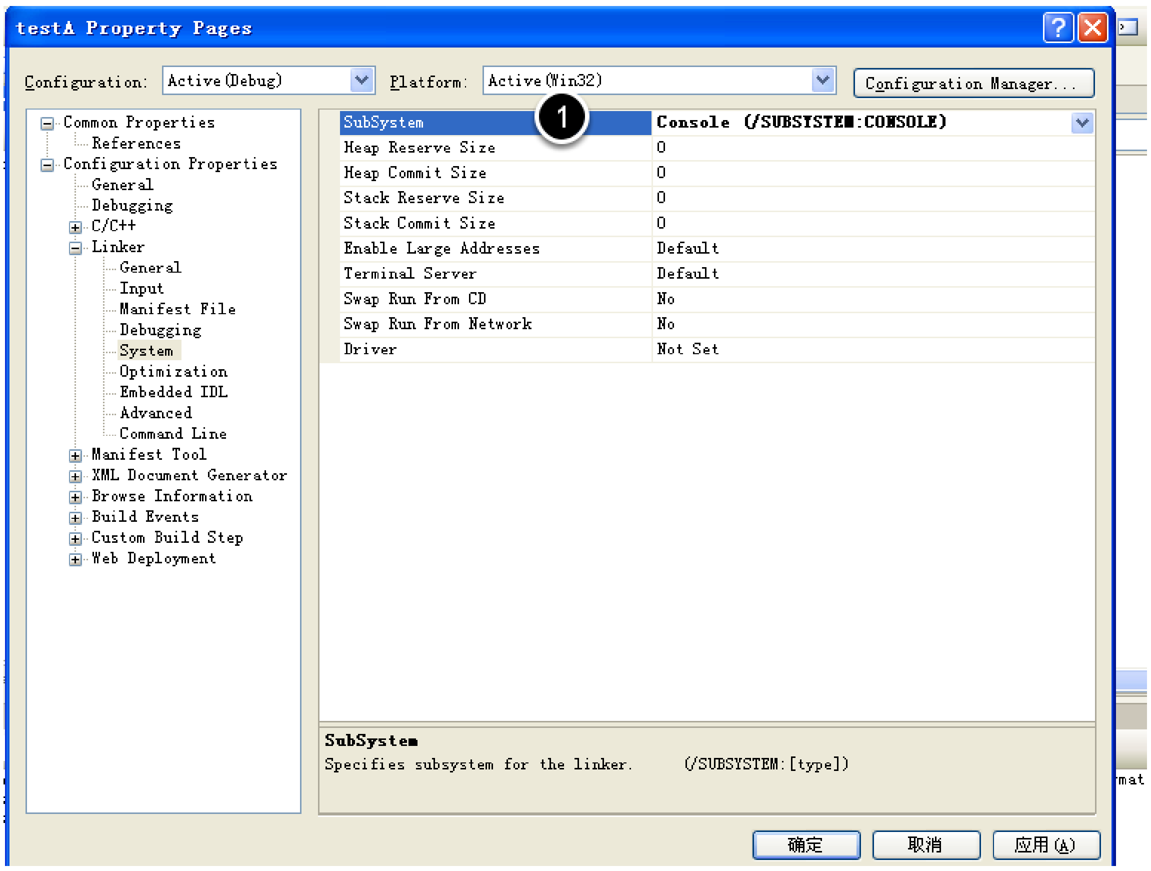


程序不能正常运行。



```
'testA.exe'                                  tings\user'
'testA.exe'                                  ntdll.dll',
'testA.exe'                                  kernel32.d
The program [5416] testA.exe: Native has exited w
```

右击 testA 选择 properties

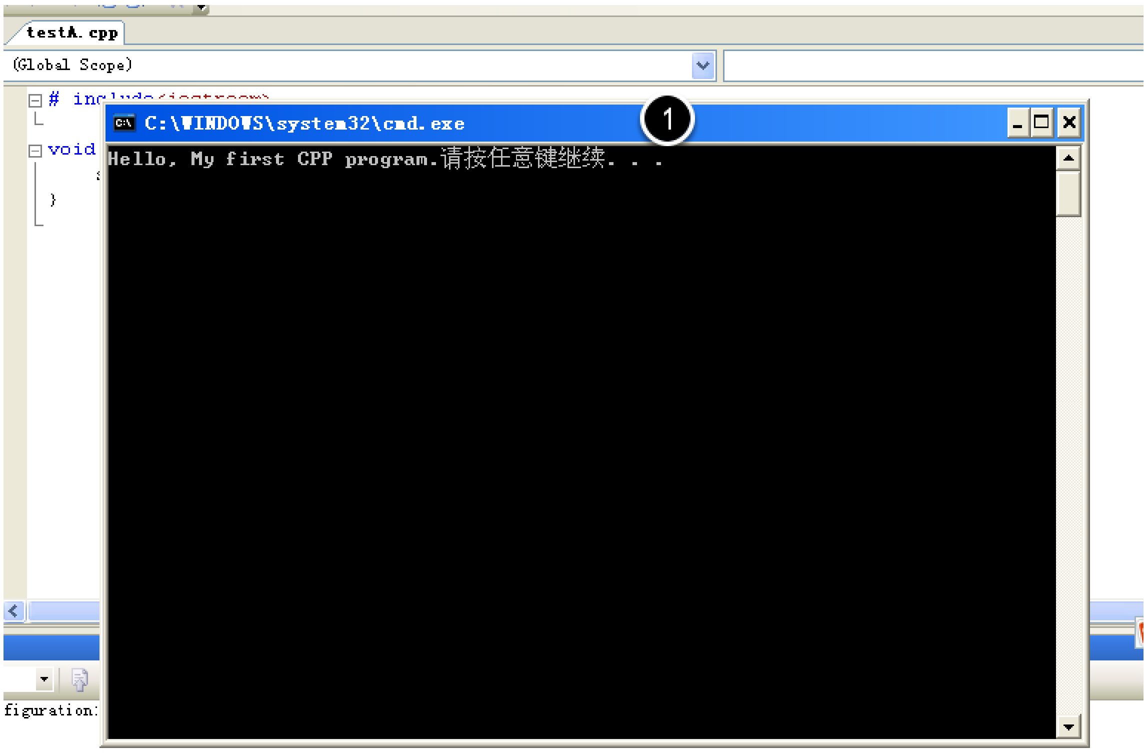


SubSystem	Console (/SUBSYSTEM:CONSOLE)
Heap Reserve Size	0
Heap Commit Size	0
Stack Reserve Size	0
Stack Commit Size	0
Enable Large Addresses	Default
Terminal Server	Default
Swap Run From CD	No
Swap Run From Network	No
Driver	Not Set

SubSystem
Specifies subsystem for the linker. (/SUBSYSTEM:[type])

Linker->SubSystem 选择下拉框里的 Console

1.2.6 用 Ctrl+F5 运行

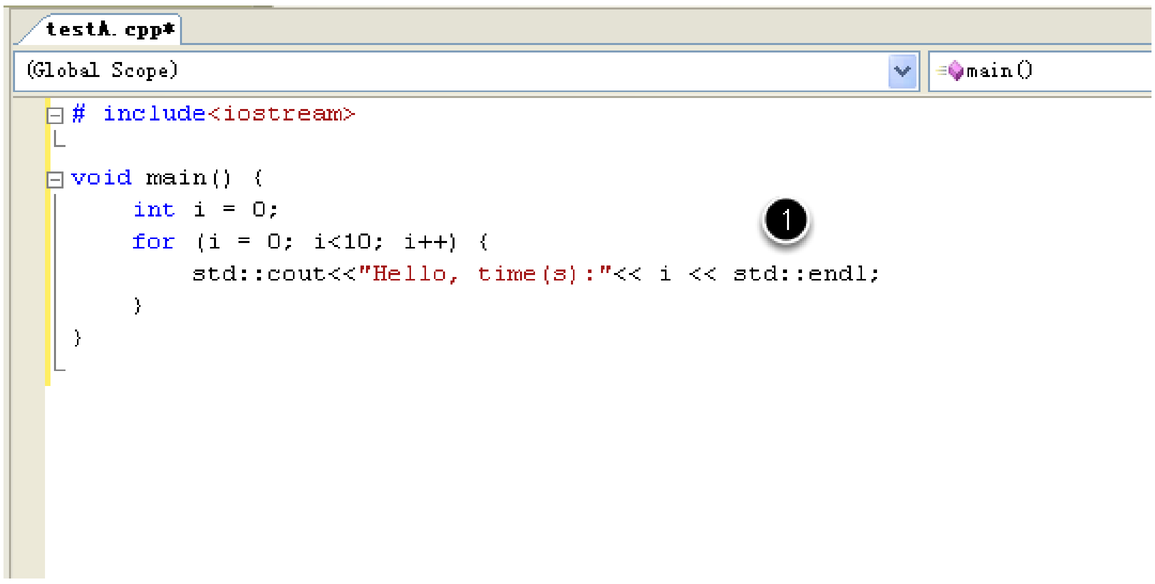


```
Hello, My first CPP program.请按任意键继续. . .
```

接下来， 用 Ctrl + F5, 来执行程序，就可以看到希望的黑色窗口了。注意 如果使用 F5 来执行还是看不见运行结果的。
两种执行方式的区别在于：
F5 run with debug
Ctrl + F5 run without debug.

如果你要自己看运行结果就用 Ctrl+F5
如果想 Debug 你的 code，看错误出在哪就用 F5。
你可以再 code 最左边你想要开始的 debug 的地方设一个 breakpoint，当你按 F5，你的程序会跳到那里，你可以用 F10 或者 F11 来查看，每行代码的运行结果

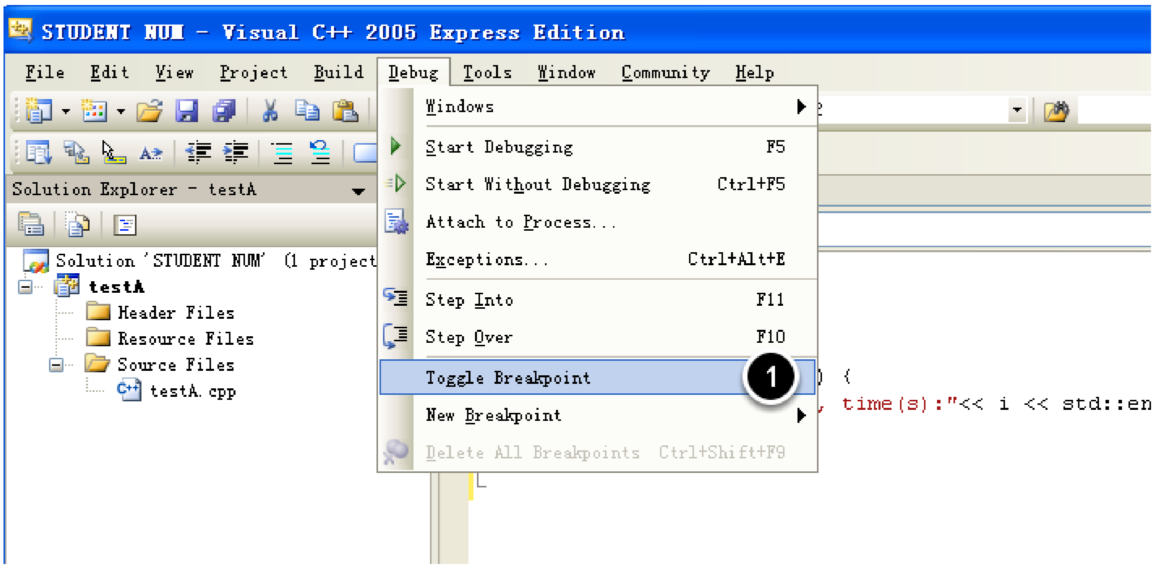
1.2.7 First Debug



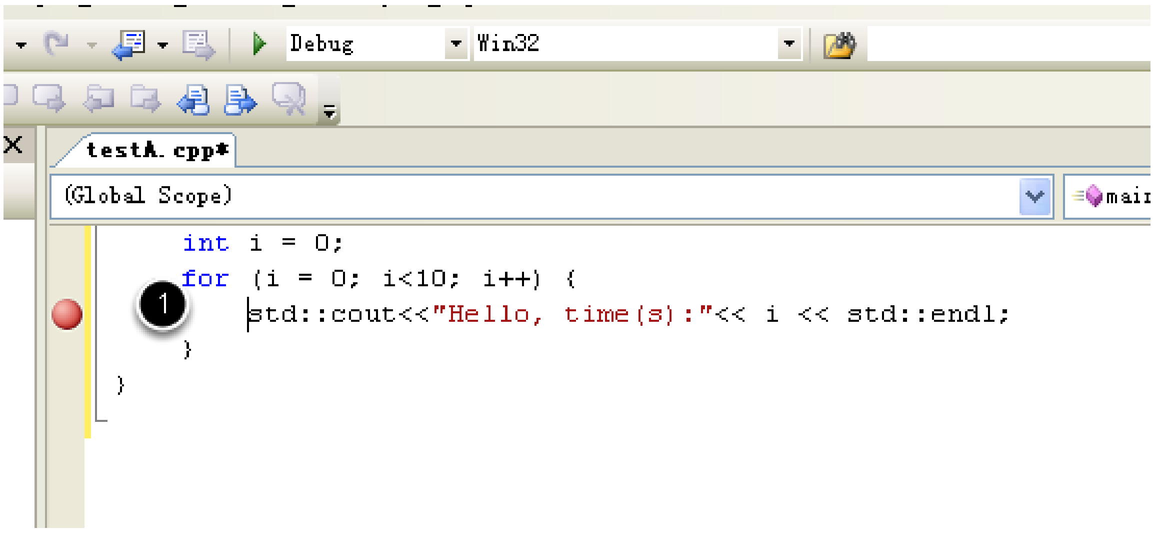
```
# include<iostream>

void main() {
    int i = 0;
    for (i = 0; i<10; i++) {
        std::cout<<"Hello, time(s):"<< i << std::endl;
    }
}
```

学习了解 Debug 功能。修改源代码为：

```
# include<iostream>

void main() {
    int i = 0;
    for (i = 0; i<10; i++) {
        std::cout<<"Hello, time(s):"<< i << std::endl;
    }
}
```
选择 std::cout<<"Hello, time(s):"<< i << std::endl;　　这句话。

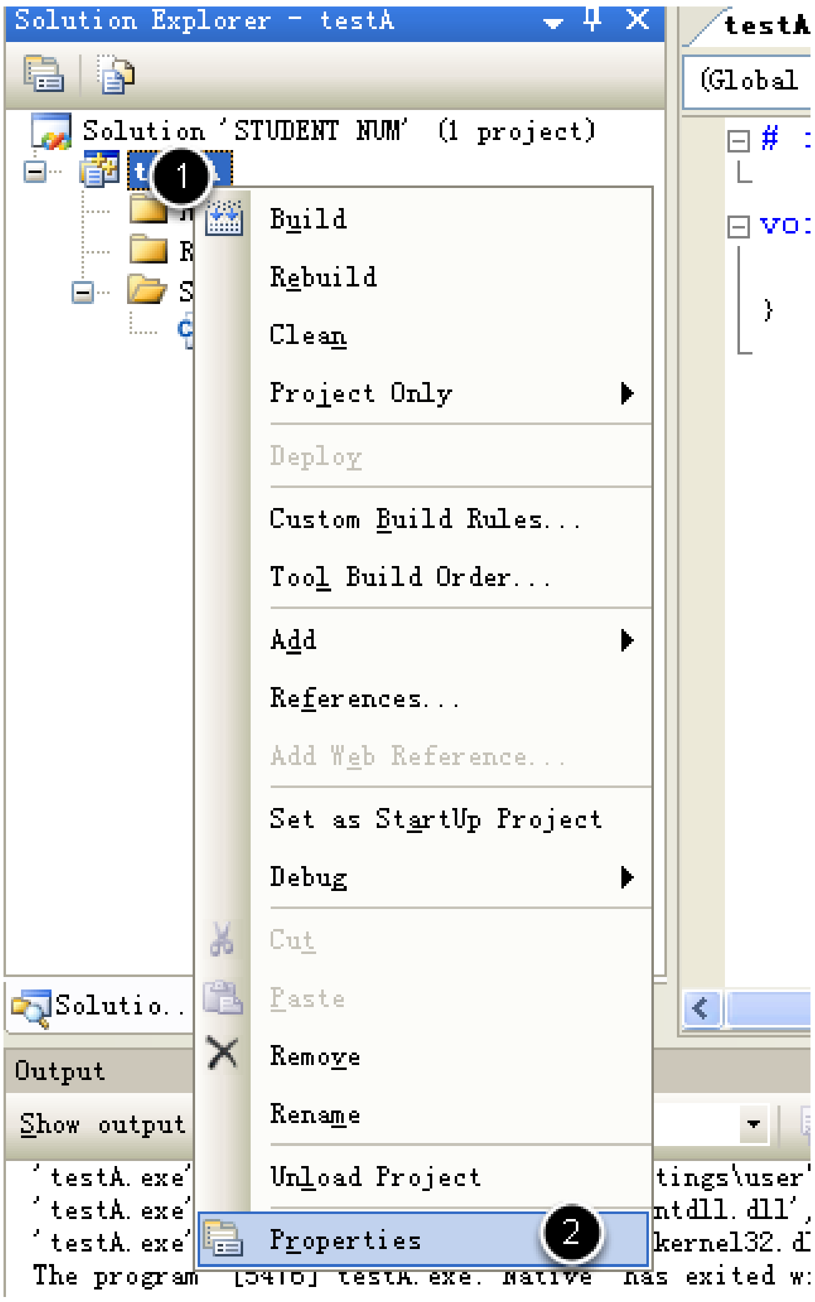


在菜单中选择 Debug->Toggle Breakpoint， 当然，直接按 F9 也可以。



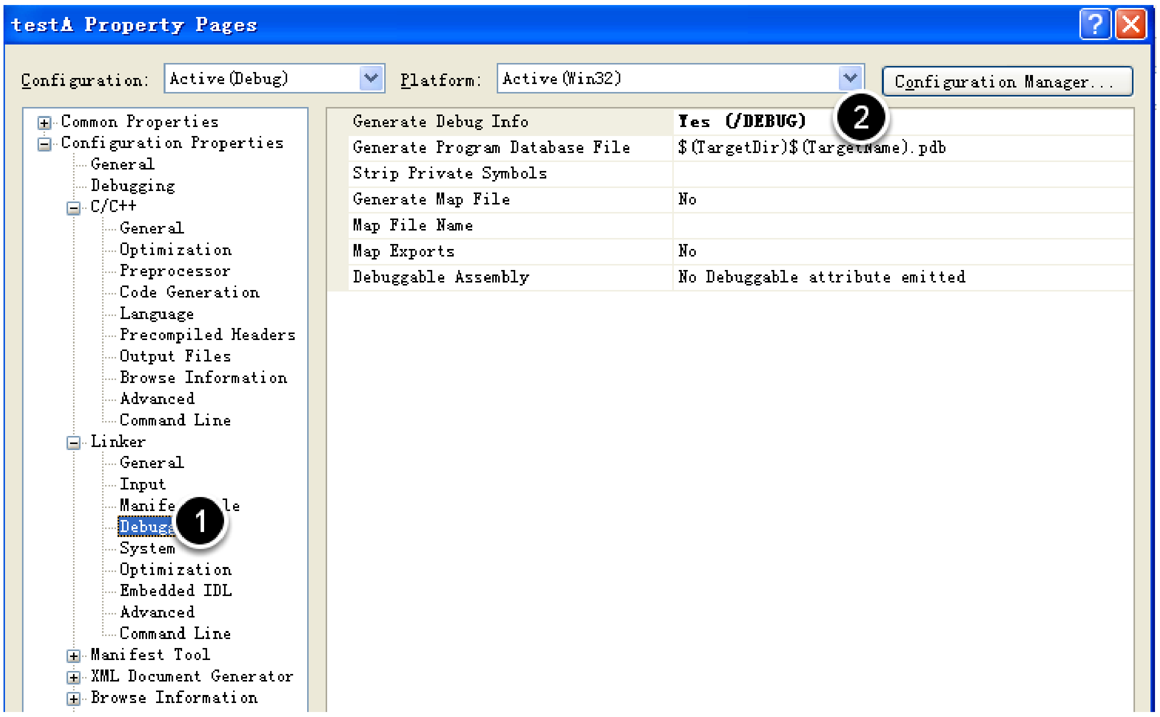
```
        int i = 0;
        for (i = 0; i<10; i++) {
            std::cout<<"Hello, time(s):"<< i << std::endl;
        }
    }
```

则在这句话前面出现了一个 红色 的标记， 称为 断点。



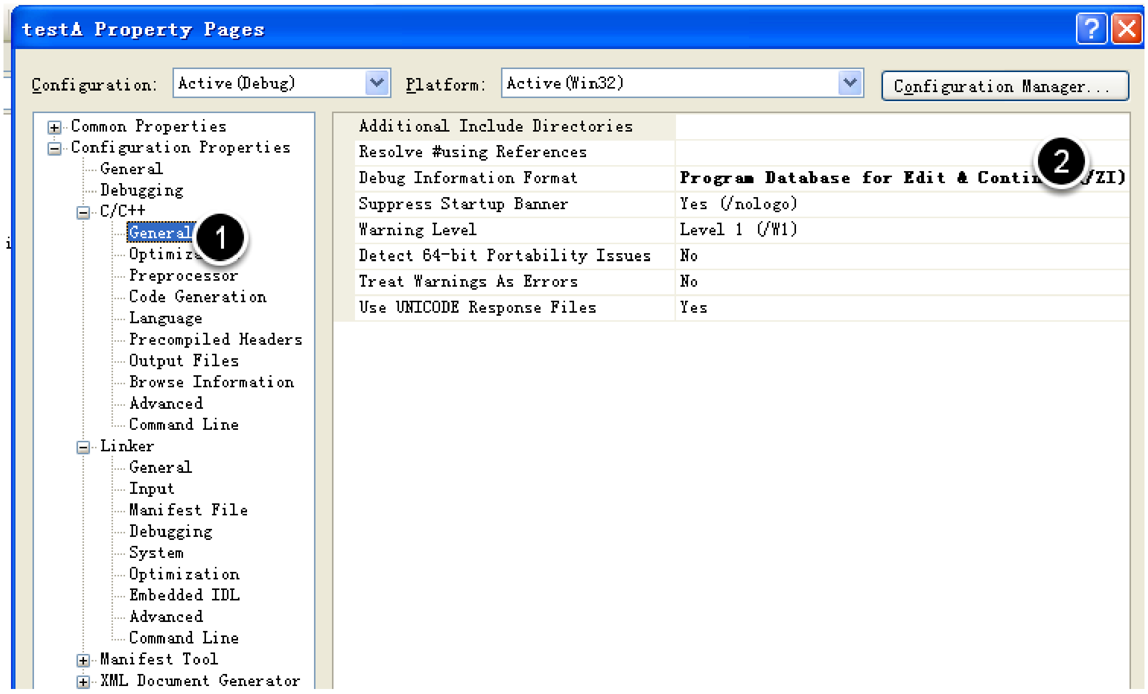
```
'testA.exe'                                      tings\user'
'testA.exe'                                      ntdll.dll',
'testA.exe'                                      kernel32.dl
The program  [5416] testA.exe: Native  has exited w:
```

调试之前需要 更改一些属性。



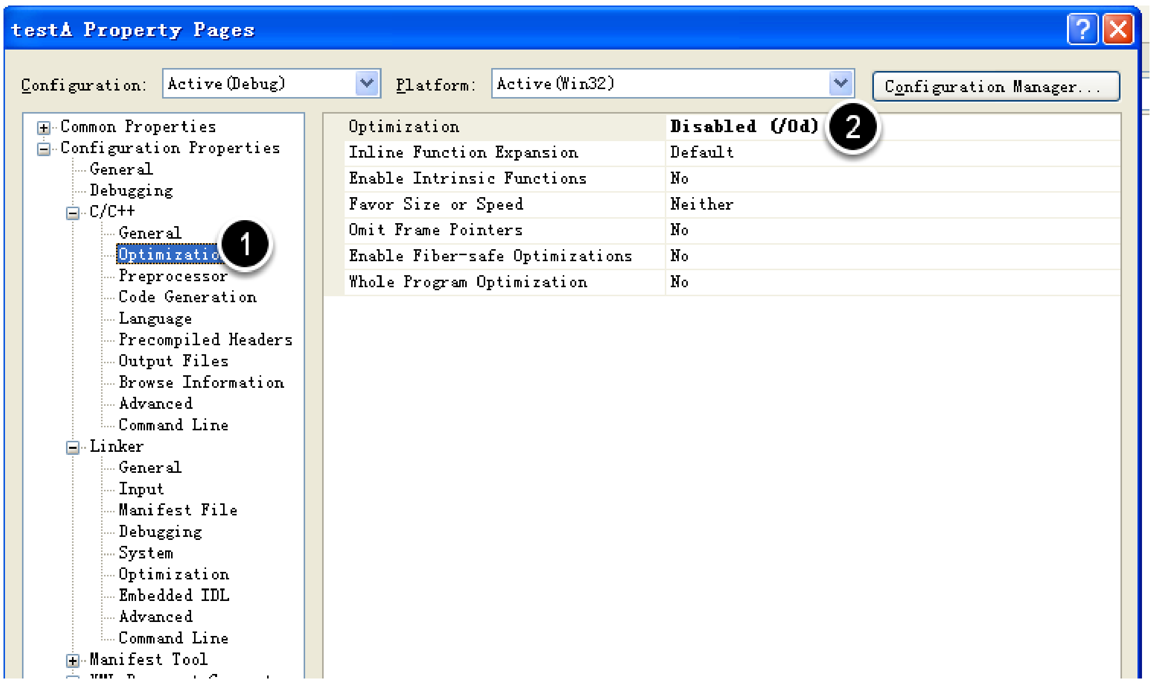
Generate Debug Info	**Yes (/DEBUG)**
Generate Program Database File	$(TargetDir)$(TargetName).pdb
Strip Private Symbols	
Generate Map File	No
Map File Name	
Map Exports	No
Debuggable Assembly	No Debuggable attribute emitted

Linker->Debugger->Generate Debug Info 改为 Yes。



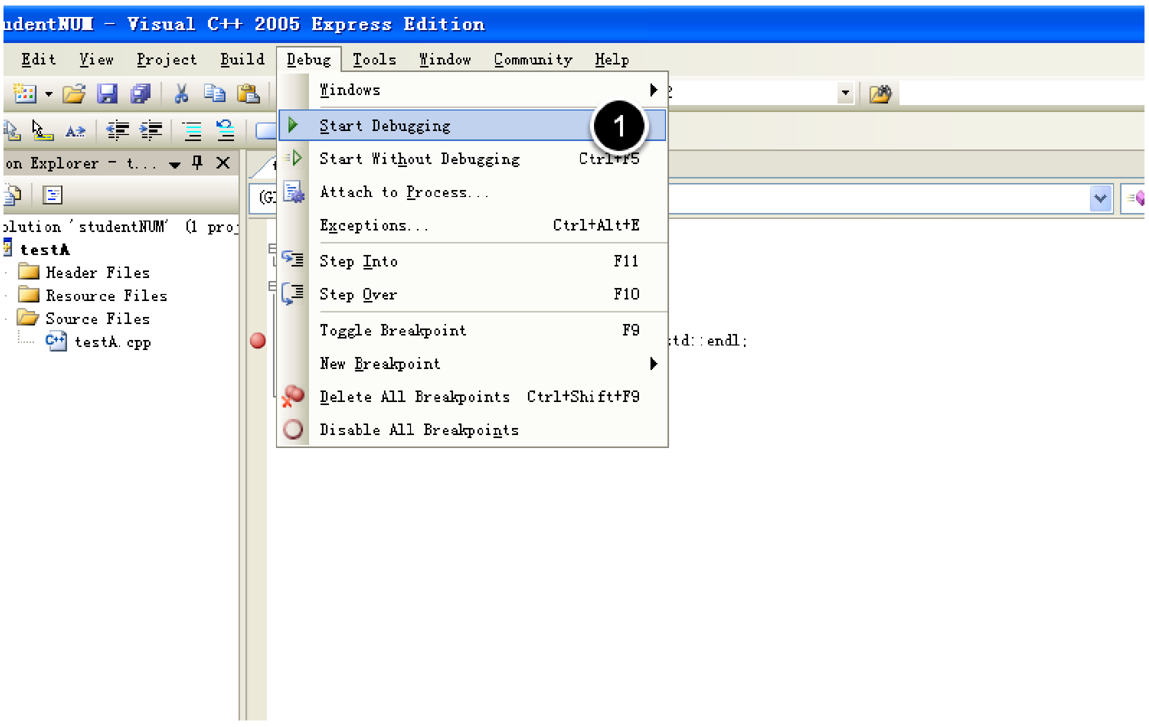
Additional Include Directories	
Resolve #using References	
Debug Information Format	**Program Database for Edit & Conti /ZI)**
Suppress Startup Banner	Yes (/nologo)
Warning Level	Level 1 (/W1)
Detect 64-bit Portability Issues	No
Treat Warnings As Errors	No
Use UNICODE Response Files	Yes

C/C++->General->Debug Information Format->ZI

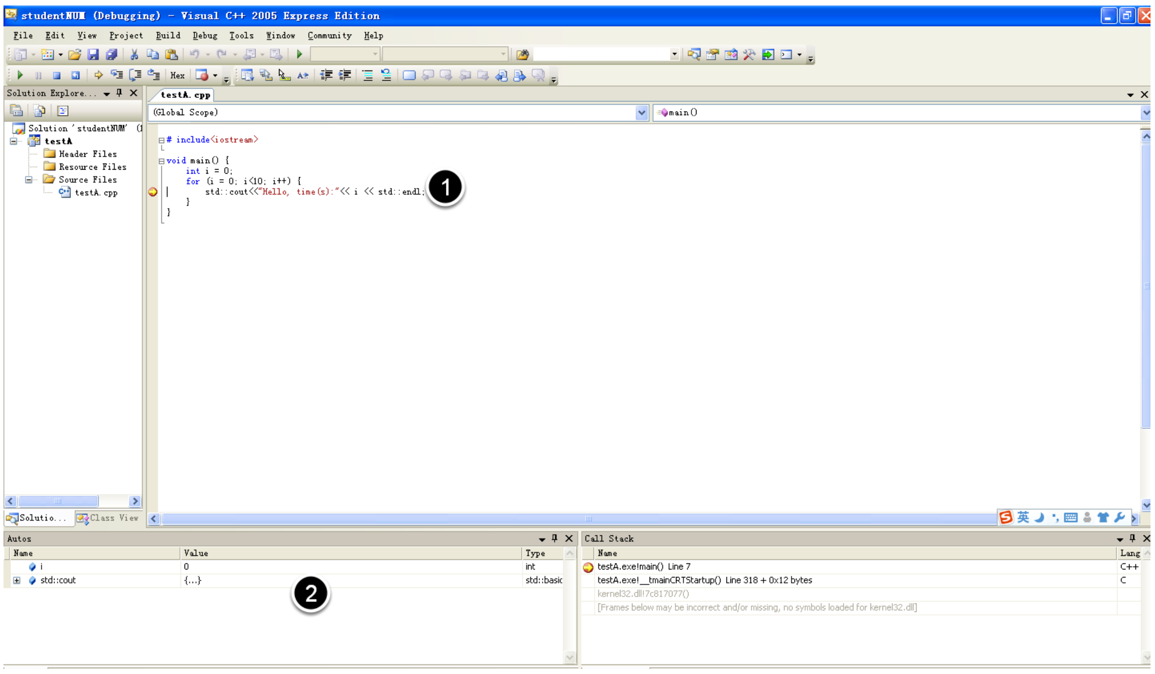


Optimization	**Disabled (/Od)**
Inline Function Expansion	Default
Enable Intrinsic Functions	No
Favor Size or Speed	Neither
Omit Frame Pointers	No
Enable Fiber-safe Optimizations	No
Whole Program Optimization	No

C/C++->Optimization->Optimization->Disabled



在菜单中选择 调试 -- 启动调试， 当然，直接按 F5 也可以。



```
# include<iostream>

void main() {
    int i = 0;
    for (i = 0; i<10; i++) {
        std::cout<<"Hello, time(s):"<< i << std::endl;
    }
}
```

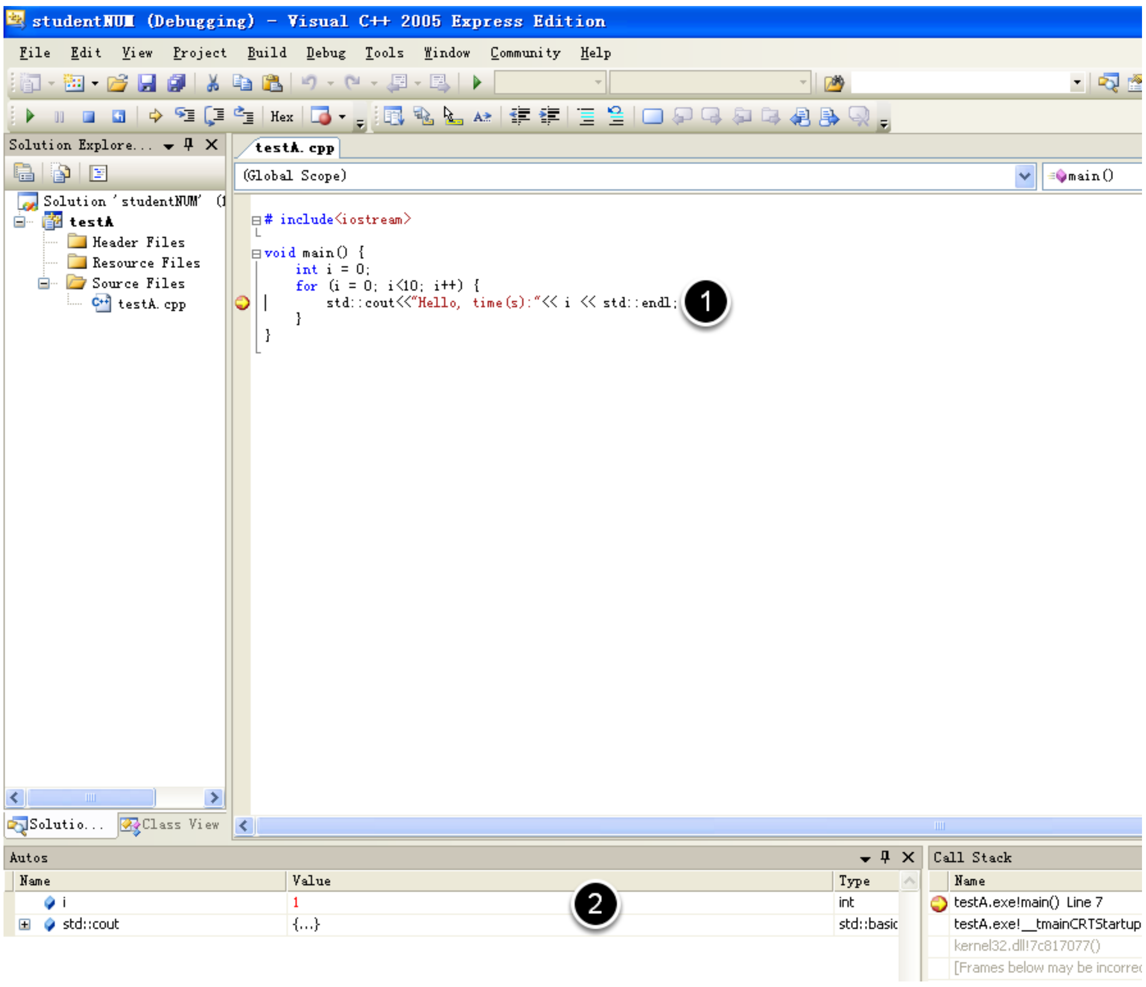
Autos

Name	Value	Type
i	0	int
std::cout	{...}	std::basic

Call Stack

Name	Lang
testA.exe!main() Line 7	C++
testA.exe!__tmainCRTStartup() Line 318 + 0x12 bytes	C
kernel32.dll!7c817077()	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel32.dll]	

程序执行到断点所在位置并停顿下来， 下面的自动窗口，给出了代码中变量的值， 可以看见变量 i = 0.



```
# include<iostream>

void main() {
    int i = 0;
    for (i = 0; i<10; i++) {
        std::cout<<"Hello, time(s):"<< i << std::endl;
    }
}
```

Autos

Name	Value	Type
i	1	int
std::cout	{...}	std::basic

Call Stack

Name
testA.exe!main() Line 7
testA.exe!__tmainCRTStartup
kernel32.dll!7c817077()
[Frames below may be incorrec

可以按绿色按钮（F5）继续直到再次执行到断点， 也可以按 F10，按照过程跟踪。 这里选择 F5， 继续执行，直到下个断点。当程序再次停顿下来时， 变量 i= 1， 已经完成了一次循环。 程序中可以设置多个断点，关于 F5， F10，F11 的区别，请进一步学习。

第二部分 实验作业及课后习题

Lab1 Introduction to C++ Programming

Objectivities：

1. To write simple computer programs in C++.
2. To write simple input and output statements.
3. To use fundamental types.
4. Basic computer memory concepts.
5. To use arithmetic operators.
6. The precedence of arithmetic operators.
7. To write simple decision-making statements

Experiment

- **Ex1：**

输入书上 p38 例 fig02_03.cpp，熟悉编程环境。

- **Ex2：**

Description of the Problem

Write a program that inputs three integers from the keyboard, and prints the sum, average, product, smallest and largest of these numbers. The screen dialogue should appear as follows: [*Note:* 13, 27 and 14 are input by the user.]

Sample Output

```
Input three different integers: 13 27 14
Sum is 54
Average is 18
Product is 4914
Smallest is 13
Largest is 27
```

Template

```
//EX2: numbercompare.cpp
#include <iostream> // allows program to perform input and output

using std::cout; // program uses cout
using std::endl; // program uses endl
using std::cin; // program uses cin

int main()
{
int number1; // first integer read from user
int number2; // second integer read from user
int number3; // third integer read from user
int smallest; // smallest integer read from user
int largest; // largest integer read from user

cout << "Input three different integers: "; // prompt
/* Write a statement to read in values for number1, number2 and
number3 using a single cin statement */

largest = number1; // assume first integer is largest

/* Write a statement to determine if number2 is greater than
largest. If so assign number2 to largest */

/* Write a statement to determine if number3 is greater than
largest. If so assign number3 to largest */

smallest = number1; // assume first integer is smallest

/* Write a statement to determine if number2 is less than
smallest. If so assign number2 to smallest */

/* Write a statement to determine if number3 is less than
smallest. If so assign number3 to smallest */

/* Write an output statement that prints the sum, average,
product, largest and smallest */

return 0; // indicate successful termination

} // end main
```

Problem-Solving Tips

1. Prompt the user to input three integer values. You will use a single cin statement to read all three values.

2. Sometimes it is useful to make an assumption to help solve or simplify a problem. For example, we assume number1 is the largest of the three values and assign it to largest. You will use if statements to determine whether number2 or number3 are

larger.
3. Using an if statement, compare largest to number2. If the content of number2 is larger, then store the variable’s value in largest.
4. Using an if statement, compare largest to number3. If the content of number3 is larger, then store the variable’s value in largest. At this point you are guaranteed to have the largest value stored in largest.
5. Perform similar steps to those in Steps 2–4 to determine the smallest value.
6. Write a cout statement that outputs the sum, average, product (i.e., multiplication), largest and smallest values.
7. Be sure to follow the spacing and indentation conventions mentioned in the text.
8. If you have any questions as you proceed, ask your lab instructor for assistance.

Follow-Up Questions and Activities

1. Modify your solution to use three separate cin statements rather than one. Write a separate prompt for each cin.

2. Does it matter whether < or <= is used when making comparisons to determine the smallest integer? Which did you use and why?

- ## Ex3:

Description of the Problem

Write a program that reads in two integers and determines and prints whether the first is a multiple of the second.[*Hint*: Use the modulus operator.]

Sample Output

```
Enter two integers: 22 8
22 is not a multiple of 8
```

Problem-Solving Tips

1. The input data consists of two integers, so you will need two int variables to store the input values.
2. Use cin to read the user input into the int variables.
3. Use an if statement to determine whether the first number input is a multiple of the second number input. Use the modulus operator, %. If one number divides into another evenly, the modulus operation results in 0. If the result is 0, display a message indicating that the first number is a multiple of the second number.
4. Use an if statement to determine whether the first number input is not a multiple of the second number input. If one number does not divide into another evenly, the modulus operation results in a non-zero value. If non-zero, display a message indicating that the first number is not a multiple of the second.
5. Be sure to follow the spacing and indentation conventions mentioned in the text.
6. If you have any questions as you proceed, ask your lab instructor for assistance.

- ## Ex4:

Problem Description

Write a program that inputs a five-digit number, separates the number into its individual digits and prints the digits separated from one another by three spaces each. [Hint: Use integer division and the modulus operator.]For example, if the user inputs 42339, the program should print what is shown in the the sample output.

Sample Output

```
4 2 3 3 9
```

Template

```
// ex4
#include <iostream> // allows program to perform input and output

using std::cout; // program uses cout
using std::endl; // program uses endl
using std::cin; // program uses cin

int main()
{
int number; // integer read from user

cout << "Enter a five-digit integer: "; // prompt
cin >> number; // read integer from user

/* Write a statement to print the left-most digit of the
5-digit number */
/* Write a statement that changes number from 5-digits
to 4-digits */
/* Write a statement to print the left-most digit of the
4-digit number */
/* Write a statement that changes number from 4-digits
to 3-digits */
/* Write a statement to print the left-most digit of the
3-digit number */
/* Write a statement that changes number from 3-digits
to 2-digits */
/* Write a statement to print the left-most digit of the
2-digit number */
/* Write a statement that changes number from 2-digits
to 1-digit */
cout << number << endl;

return 0; // indicate successful termination
34
35 } // end main
```

Problem-Solving Tips

1. The input data consists of one integer, so you will use an int variable (number) to represent it. Note that the description indicates that one five-digit number is to be input—not five separate digits.
2. You will use a series of statements to "break down" the number into its individual digits using modulus (%) and division (/) calculations.
3. After the number has been input using cin, divide the number by 10000 to get the leftmost digit.Why does this work? In C++, dividing an integer by an integer results in an integer. For example, 42339 /10000 evaluates to 4 because 10000 divides evenly into 42339 four times. The remainder 2339 is truncated.
4. Change the number to a 4-digit number using the modulus operator. The number modulus 10000 evaluates to the integer remainder—in this case, the right-most four digits. For example, 42339 % 10000 results in 2339. Assign the result of this modulus operation to the variable that stores the five-digit number input.
5. Repeat this pattern of division and modulus reducing the divisor by a factor of 10 each time (i.e., 1000,100, 10). After the number is changed to a four-digit number, divide/modulus by 1000. After the number is changed to a three-digit number, divide/modulus by 100. And so on.
6. Be sure to follow the spacing and indentation conventions mentioned in the text.
7. If you have any questions as you proceed, ask your lab instructor for assistance.

Follow-Up Questions and Activities

1. What happens when the user inputs a number which has fewer than five digits? Why? What is the output when 1763 is entered?
2. The program you completed in this lab exercise inputs a number with multiple digits and separates the digits。 Write the inverse program, a program which asks the user for three one-digit numbers and combines them into a single three-digit number. [Hint: Use multiplication and addition to form the three-digit number.]

.

Homework

2.10
2.24
2.27

Lab2 Introduction to Classes and Objects

Objectivities

1. How to define a class and use it to create an object
2. How to define member functions in a class to implement the class' s behaviors.
3. How to declare data members in a class to implement the class' s attributes.

4. How to call a member function of an object to make that member function perform its task.
5. The differences between data members of a class and local variables of a function.
6. How to use a constructor to ensure that an object’ s data is initialized when the object is created.
7. How to engineer a class to separate its interface from its implementation and encourage reuse.

Experiments

● Ex1(p.99--3.11)

Description of the Problem

Modify class GradeBook (Figs. 3.11 and Figs. 3.12). Include a second string data member that represents thename of the course’s instructor. Provide a *set* function to change the instructor’s name and a *get* function to retrieve it. Modify the constructor to specify two parameters—one for the course name and one for the instructor’s name. Modify member function display Message such that it first outputs the welcome message and course name, then outputs "This course is presented by: " followed by the instructor’s name. Modify the test application to demonstrate the class’s new capabilities.

Sample Output

```
Welcome to the grade book for
CS101 Introduction to C++ Programming!
This course is presented by: Sam Smith
Changing instructor name to Judy Jones
Welcome to the grade book for
CS101 Introduction to C++ Programming!
This course is presented by: Judy Jones
```

Problem-Solving Tips

1. In class GradeBook, declare a string data member to represent the instructor’s name.
2. Declare a public *set* function for the instructor’s name that does not return a value and takes a string as a parameter. In the body of the *set* function, assign the parameter’s value to the data member that represents the instructor’s name.
3. Declare a public *get* function that returns a string and takes no parameters. This member function should return the instructor’s name.
4. Modify the constructor to take two string parameters. Assign the parameter that represents the instructor’s name to the appropriate data member.
5. Add a cout statement to member function displayMessage to output the value of the data member you declared earlier.
6. Be sure to follow the spacing and indentation conventions mentioned in the text.
7. If you have any questions as you proceed, ask your lab instructor for help.

● Ex2(p.100--3.14)

Sample Output

```
Employee 1: Bob Jones; Yearly Salary: 34500
Employee 2: Susan Baker; Yearly Salary: 37800
Increasing employee salaries by 10%
Employee 1: Bob Jones; Yearly Salary: 37944
Employee 2: Susan Baker; Yearly Salary: 41580
```

Problem-Solving Tips

1. Class Employee should declare three data members.

2. The constructor must declare three parameters, one for each data member. The value for the salary should be validated to ensure it is not negative.

3. Declare a public *set* and *get* functions for each data member. The *set* functions should not return values and should each specify a parameter of a type that matches the corresponding data member (string for first name and last name, int for the salary). The *get* functions should receive no parameters and should specify a return type that matches the corresponding data member.

4. When you call the constructor from the main function, you must pass it three arguments that match the parameters declared by the constructor.

5. Giving each employee a raise will require a call to the *get* function for the salary to obtain the current salary and a call to the *set* function for the salary to specify the new salary.

6. Be sure to follow the spacing and indentation conventions mentioned in the text.

7. If you have any questions as you proceed, ask your lab instructor for help.

Homework

3.5
3.13
3.15

Lab3 Control Statements: Part I

Objectivities：

1. Basic problem-solving techniques.
2. To develop algorithm through the process of top-down, stepwise refinement.
3. Counter-controlled repetition and sentinel-controlled repetition.
4. To use the **if** and **if**…**else** selection statements to choose among alternative actions.
5. To use the **while** repetition statement to execute statements in a program repeatedly.

Experiment

- **Ex1、Problem**

(P142) 4.17 The process of finding the largest number (i.e., the maximum of a group of numbers) is used frequently in computer applications. For example, a program that determines the winner of a sales contest inputs the number of units sold by each salesperson. The salesperson who sells the most units wins the contest.

Your program should use three variables, as follows:

- `counter`: A counter to count to 10 (i.e., to keep track of how many numbers have been input and to determine when all 10 numbers have been processed).
- `number`: The current number input to the program.
- `largest`: The largest number found so far.

✓ Content and Requirement:

1. Write a pseudocode program.
2. Write a C++ program
    a) To input 10 numbers **from keyboard** by the user.
    b) To use a `while` and `if` statement to determine the largest number.
    c) To **prin**t the largest number.
3. Execute the program.

- **Ex2、Problem**

(P145) 4.26 A Palindrome is a number or text phrase that reads the dame backward as forward. For example, each of the following five-digit integers is a palindrome: 12321, 55555, 45554 and 11611.

✓ Content and Requirement:

1. Write a C++ program
    a) To reads in a five-digit integer.
    b) To use a `while` and `if`...`else` statement to determine whether it is a palindrome.
    c) To **Output** “the five-digit integers is a palindrome!” or “It is not a palindrome!”.
2. Execute the program.

✓ *Hint:*

Use the division and modulus operators to separate the number into its individual digits.

Homework

4.27, 4.34, 4.35(b)

Lab4 Control Statements II

Objective

- The essentials of counter-controlled repetition.
- To use the **for** and **do…while** repetition statements to execute statements in a program repeatedly.
- To understand multiple selection using the **switch** selection statement.
- To use the **break** and **continue** program control statements to alter the flow of control.

- To use the logical operators to form complex conditional expressions in control statements.
- To avoid the consequences of confusing the equality and assignment operators.

Experiments

- **Ex 1: Integer Average (课后习题5.6)**

Lab Objectives

• Using sentinel-controlled repetition with a **for** loop.

The follow-up question and activity also will give you practice:

• Using counter-controlled repetition with a **for** loop.

Description of the Problem

Write a program that uses a for statement to calculate and print the average of several integers. Assume the last value read is the sentinel **9999**. A typical input sequence might be **10 8 11 7 9 9999** indicating that the program should calculate the average of all the values preceding **9999**.

Sample Output

```
Enter integers (9999 to end):
10 8 11 7 9 9999
The average is: 9
```

Template

```
// Lab 1: IntegerAverage.cpp
// Calculate the average of several integers.

#include <iostream>
using std::cin;
using std::cout;
using std::endl;

int main()
{
  int value; // current value
  int count = 0; // number of inputs
  int total; // sum of inputs

  // prompt for input
  cout << "Enter integers (9999 to end):" << endl;
  cin >> value;

  // loop until sentinel value read from user
  /* Write a for header to initialize total to 0
    and loop until value equals 9999 */
  {
    /* Write a statement to add value to total */
    /* Write a statement to increment count */

    cin >> value; // read in next value
  } // end for

  // if user entered at least one value
  if (count != 0 )
        cout << "\nThe average is: "
        << /* Convert total to a double and divide it by count */ << endl;
  else
        cout << "\nNo values were entered." << endl;

  return 0; // indicate program ended successfully
} // end main
```

Problem-Solving Tips

1. When used for sentinel-controlled repetition, a **for** loop can be written much like a **while** loop, using the same loop-continuation condition as a **while** loop.
2. When performing sentinel-controlled repetition, a **for** loop does not need to increment any counter variable. But it can still initialize a variable if so desired.

Follow-up Question

1. Modify the program to perform counter-controlled repetition with a **for** loop. Assume that the first integer entered by the user represents the number of subsequent integers that the user will input to be averaged.

   Sample output:

```
Enter integers (first integer should be the number of subsequent integers):
5 12 7 4 19 6
The average is: 9.6
```

● Ex 2: Pythagorean Triples (课后习题5.20)

Lab Objectives

• Using counter-controlled repetition.
• Using “brute force” to solve a problem.
• Nesting for loops.

The follow-up questions and activities will also give you practice:

• Using **break** statements.
• Using **continue** statements.

• Using **long** integers.

Description of the Problem

A right triangle can have sides that are all integers. A set of three integer values for the sides of a right triangle is called a Pythagorean triple. These three sides must satisfy the relationship that the sum of the squares of two of the sides is equal to the square of the hypotenuse. Find all Pythagorean triples for ***side1***, ***side2*** and ***hypotenuse*** all no larger than 500. Use a triple-nested for loop that tries all possibilities. This is an example of “brute force computing.” You will learn in more advanced computer-science courses that there are many interesting problems for which there is no known algorithmic approach other than using sheer brute force.

Sample Output

```
Side 1    Side 2    Side3
3         4         5
5         12        13
6         8         10
7         24        25
...
319       360       481
320       336       464
325       360       485
340       357       493
A total of 386 triples were found.
```

Template

```
// Lab 2: pythagorean.cpp
// Find Pythagorean triples using brute force computing.
#include <iostream>
using std::cout;
using std::endl;

int main()
{
  int count = 0; // number of triples found
  long int hypotenuseSquared; // hypotenuse squared
  long int sidesSquared; // sum of squares of sides

  cout << "Side 1\tSide 2\tSide3" << endl;

  // side1 values range from 1 to 500
  /* Write a for header for side1 */
  {
      // side2 values range from current side1 to 500
```

```
    /* Write a for header for side2 */
    {
        // hypotenuse values range from current side2 to 500
        /* Write a for header for hypotenuse */
        {
            // calculate square of hypotenuse value
            /* Write a statement to calculate hypotenuseSquared */

            // calculate sum of squares of sides
            /* Write a statement to calculate the sum of the sides Squared */

            // if (hypotenuse)^2 = (side1)^2 + (side2)^2,
            // Pythagorean triple
            if ( hypotenuseSquared == sidesSquared )
            {
                // display triple
                cout << side1 << '\t' << side2 << '\t'
                      << hypotenuse << '\n';
                count++; // update count
              } // end if
          } // end for
      } // end for
  } // end for

  // display total number of triples found
  cout << "A total of " << count << " triples were found." << endl;
  return 0; // indicate successful termination
} // end main
```

Problem-Solving Tips

1. This program does not require any input from the user.
2. This program can take a significant amount of time to run, depending on your computer's processor speed. If you have a CPU monitor available on your system, it is worth taking a look at it when this program executes.
3. Do not be concerned that you are trying values that do not seem to make sense, such as a 1–1–500 triangle.
4. Remember that brute-force techniques try all possible values.
5. The formula for the Pythagorean Theorem is ***hypotenuse***^{2} = (***side 1***)^2 + (***side 2***)^2.
6. To avoid producing duplicate Pythagorean triples, start the second for loop at ***side2*** = ***side1*** and the third for loop at ***hypotenuse*** = ***side2***. This way, when a Pythagorean triple is found, side1 will be the shortest side of the triangle and hypotenuse will be the longest side.

Follow-up Question

1. How many times did this program execute the innermost for loop? Add another counter to the program that counts the number of times this loop iterates. Declare a new variable of type **long**, named ***loopCounter*** and initialize it to 0. Then add a statement in the innermost for statement that increments ***loopCounter*** by 1. Before exiting the program, print the value of ***loopCounter***. Do the numbers match?
2. Add a **break** statement to the program inside the innermost for loop. This **break** statement should be called after the 20th Pythagorean triple is found. Explain what happens to the program after the 20th triple is found. Are all three for loops exited, or just the innermost one? What happens when the **break** statement is placed inside the middle loop? The outermost loop?
3. Add a **continue** statement to the program that prevents a Pythagorean triple from being found when side1 is equal to 8. Using your solution to *Follow-Up Question 1*, calculate how many times this new program executes the innermost for loop. Explain why the **continue** statement affected the output.
4. Explain why a **long** variable is used for ***hypotenuseSquared*** and ***sideSquared***. Modify the program so that they are both of type **short** instead of type **long**. Rerun the program. What happens?

Homework

Ex 5.8, Ex5.9 (**for** loop),
Ex 5.14 (**for** / **while** and **switch** statements),
Ex 5.17, Ex 5.22 (logical operators),
Ex 5.7, Ex 5.26, Ex 5.12 (nested **for** loops)
Ex5.23

Lab5 Function and Recursion

Objective

1．掌握模块化构建程序的方法
2．掌握函数定义、函数声明、参数传递的方法
3．掌握利用随机数生成机制实现模拟技术
4．编写 C++程序：函数调用和递归调用
5．理解作用域的概念，以及标识符是如何被限制在程序的特定区域中
6．理解参数传递中传值调用与传引用调用之间的区别，何时应用传值调用，何时应用传引用调用

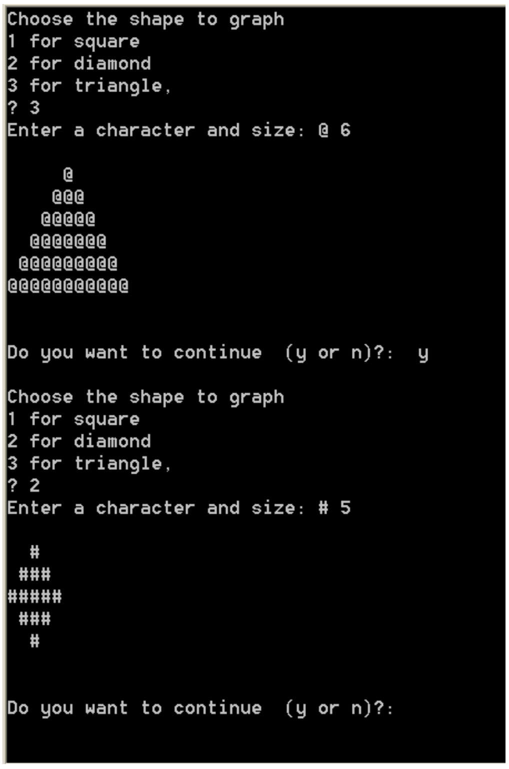
Experiments

● 1、习题 6.24
问题描述

（英文）Use techniques similar to those developed in 6.22 and 6.23 to produce a program that graphs a wide range of shapes.

（中文）分别用三个函数实现绘制正方形(square)、菱形(diamond)、三角形(triangle)，在 main 函数中用循环结构嵌套 switch 结构实现对各种图形函数的调用测试。

实例输出



```
Choose the shape to graph
1 for square
2 for diamond
3 for triangle,
? 3
Enter a character and size: @ 6

     @
    @@@
   @@@@@
  @@@@@@@
 @@@@@@@@@
@@@@@@@@@@@


Do you want to continue  (y or n)?:  y

Choose the shape to graph
1 for square
2 for diamond
3 for triangle,
? 2
Enter a character and size: # 5

  #
 ###
#####
 ###
  #


Do you want to continue  (y or n)?:
```

- **2、(习题 6.29)：**

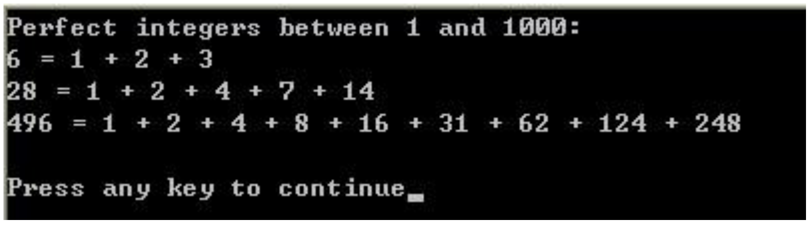
问题描述

(英文) (Perfect Numbers) An integer is said to be a perfect number if the sum of its factors, including 1 (but not the number itself), is equal to the number. For example, 6 is a perfect number, because 6 = 1 + 2 + 3. Write a function perfect that determines whether parameter number is a perfect number. Use this function in a program that determines and prints all the perfect numbers between 1 and 1000. Print the factors of each perfect number to confirm that the number is indeed perfect. Challenge the power of your computer by testing numbers much larger than 1000.

(中文) 一个完全数是这样的一个整数，它的所有因子（包含 1 但不包含该数本身）的和恰好等于该数本身。举个例子，6 是一个完全数，因为 6=1+2+3。编写一个函数 perfect(bool 类型返回值)，用它来判断该函数的形式参数是否为一个完全数。在程序中调用该函数，找出 1 至 1000 这个范围内所有的完全数并打印出来。并且将这些找出来的完全数的因子打印出来，用来确认该数确实是一个完全数。你可以通过测试数值在 1000 以上的完全数来挑战

你计算机的能力。

实例输出



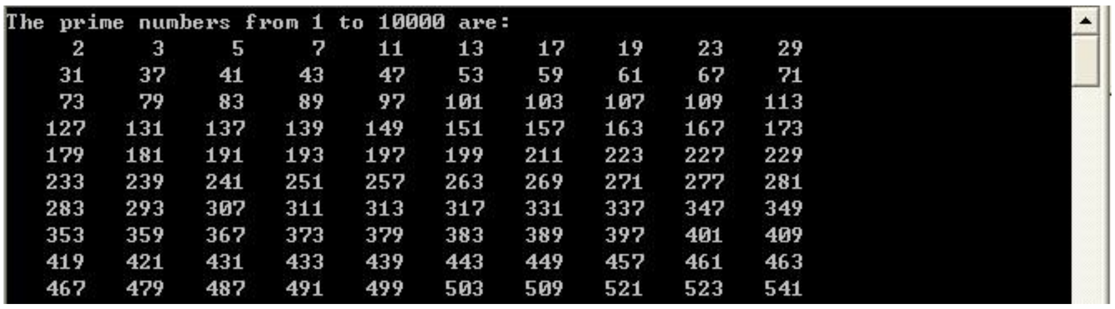
```
Perfect integers between 1 and 1000:
6 = 1 + 2 + 3
28 = 1 + 2 + 4 + 7 + 14
496 = 1 + 2 + 4 + 8 + 16 + 31 + 62 + 124 + 248

Press any key to continue
```

- **3、（习题 6.30）：**

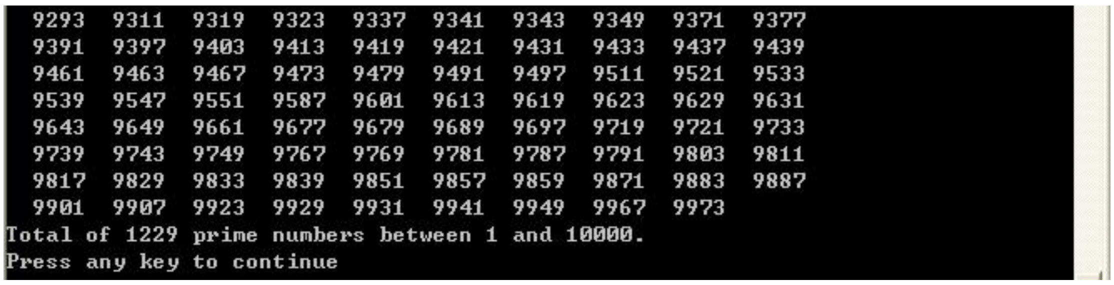
问题描述

(英文) (PrimeNumbers) An integer is said to be prime if it is divisible by only 1 and itself. For example, 2, 3, 5 and 7 are prime, but 4, 6, 8 and 9 are not.
1. Write a function that determines whether a number is prime.
2. Use this function in a program that determines and prints all the prime numbers between 2 and 10,000. How many of these numbers do you really have to test before being sure that you have found all the primes?
3. Initially, you might think that n/2 is the upper limit for which you must test to see whether a number is prime, but you need only go as high as the square root of n. Why? Rewrite the program, and run it both ways. Estimate the performance improvement.
（中文）（质数问题）一个质数是这样的一个整数，它只能被 1 和该数本身整除。举个例子，2，3，4，7 是质数，而 4，6，8，9 不是质数。
1.编写一个函数来判断一个数是否为质数。
2.在程序中调用这个函数，找出 2 至 10000 这个范围内所有的质数并且打印出来。在你确认找出所有质数之前你测试了多少次呢？
3.最初，你可能认为判断一个数是否为质数的测试次数上限为 n/2，但实际你需要的测试次数的上限只是 n 的平方根。这是为什么呢？重新编写这个程序，分别在这两种方式下运行，并观察出性能的改进。

实例输出



```
The prime numbers from 1 to 10000 are:
     2     3     5     7    11    13    17    19    23    29
    31    37    41    43    47    53    59    61    67    71
    73    79    83    89    97   101   103   107   109   113
   127   131   137   139   149   151   157   163   167   173
   179   181   191   193   197   199   211   223   227   229
   233   239   241   251   257   263   269   271   277   281
   283   293   307   311   313   317   331   337   347   349
   353   359   367   373   379   383   389   397   401   409
   419   421   431   433   439   443   449   457   461   463
   467   479   487   491   499   503   509   521   523   541
```



```
  9293  9311  9319  9323  9337  9341  9343  9349  9371  9377
  9391  9397  9403  9413  9419  9421  9431  9433  9437  9439
  9461  9463  9467  9473  9479  9491  9497  9511  9521  9533
  9539  9547  9551  9587  9601  9613  9619  9623  9629  9631
  9643  9649  9661  9677  9679  9689  9697  9719  9721  9733
  9739  9743  9749  9767  9769  9781  9787  9791  9803  9811
  9817  9829  9833  9839  9851  9857  9859  9871  9883  9887
  9901  9907  9923  9929  9931  9941  9949  9967  9973
Total of 1229 prime numbers between 1 and 10000.
Press any key to continue
```

- **4、（习题 6.32）：**

问题描述

(英文) The greatest common divisor (GCD) of two integers is the largest integer that evenly divides each of the numbers. Write a function GCD that returns the greatest common divisor of two integers.

(中文) 两个整型数的最大公约数(The greatest common divisor, GCD)定义为最大的整除这两个整数的数。编写 gcd 函数，返回两个整型数的最大公约数。

实例输出

```
Enter two integers: 6 8
The greatest common divisor of 6 and 8 is 2

Enter two integers: 789 4
The greatest common divisor of 789 and 4 is 1

Enter two integers: 9999 27
The greatest common divisor of 9999 and 27 is 9

Enter two integers: 73652 8
The greatest common divisor of 73652 and 8 is 4

Enter two integers: 99 11
The greatest common divisor of 99 and 11 is 11
```

步骤要求：

(1) 程序需要输入两个整数，编写一个循环语句，以便于程序一次执行就允许用户多次输入测试整数对，是一种十分便捷的测试程序。

(2) 程序中包含一个 gcd 函数，该函数完成最大公约数的求解算法。

提示：最大公约数的求解算法是应用模数运算符来计算余数，如果两个数被除后的余数均为 0，那么，除数就是公约数，然后可以从函数中返回最大公约数。

(3) 采用简单尝试的方法实现 gcd 函数，命名为 gcd0 函数。要求通过引用参数返回最大公约数；函数无返回值；三个参数，其中一个为引用参数，返回最大公约数。

(4) 采用迭代法来实现 gcd 函数，命名为 gcd1 函数。

(5) 利用调试工具，监测程序执行过程中变量的改变。

欧几里德算法提示：

首先用小的数对大的数取余：如果余数是零，那么两个数相同，或者这个较小的数就是它们的最大公约数；如果余数不为零，则继续用这次计算得出的余数对两个整数中比较小的数取余。如果余数为零，则这个比较小的数为最大公约数，如果余数不为零，则继续用本次的余数对上次获得的余数取余，如果余数为零，则上次计算得出的余数则为最大公约数，如果不为零则继续递归，直到得出最大公约数。

数 1	数 2	余
44	36	8
36	8	4

8	**4**	0

因此结果即是 4。

- **5、（习题 6.40）：**

问题描述

(英文) Write a recursive function power (base, exponent) that, when invoked, returns

$$\text{base}^{\text{exponent}}$$

For example, power(3, 4) = 3 * 3 * 3 * 3. Assume that exponent is an integer greater than or equal to 1. Hint: The recursion step would use the relationship

$$\text{base}^{\text{exponent}} = \text{base} \cdot \text{base}^{\text{exponent - 1}}$$

and the terminating condition occurs when exponent is equal to 1, because
$\text{base}^1 = \text{base}$

（中文）编写一个递归函数 power (base, exponent)，当函数被调用时，返回

$$\text{base}^{\text{exponent}}$$

例如，power(3, 4) = 3 * 3 * 3 * 3。假设指数 exponent 是一个大于或等于 0 的整数。提示：递归步骤使用关系式

$$\text{base}^{\text{exponent}} = \text{base} \cdot \text{base}^{\text{exponent - 1}}$$

和当指数 exponen=1 时，递归终止条件发生，因为此时 $\text{base}^1 = \text{base}$。

实例输出

```
Enter a base and an exponent: 3 5
3 raised to the 5 is 243
```

- 6、**（习题 6.40）：**

问题描述

(英文) (Fibonacci Series) The Fibonacci series

0, 1, 1, 2, 3, 5, 8, 13, 21, ...

begins with the terms 0 and 1 and has the property that each succeeding term is the sum of the two preceding terms. (a) Write a nonrecursive function fibonacci(n) that calculates the nth Fibonacci number. (b) Determine the largest int Fibonacci number that can be printed on your system. Modify the program of part (a) to use double instead of int to calculate and return Fibonacci numbers, and use this modified program to repeat part (b).

（中文）斐波那契数列

0, 1, 1, 2, 3, 5, 8, 13, 21, ...

从数值 0 和 1 开始，具有每一项斐波那契数列的值是前两项斐波那契数列的值之和的性质。（a）编写一个非递归函数 fibonacci(n)计算第 n 项斐波那契数列的值。（b）确定能打印输出在你系统中的最大的斐波那契数列的整型值。修改（a）部分的程序，使用 double 类型的值代替 int 型的值来计算和返回斐波那契数列的值，并且使用这修改过的程序来实现（b）部分的功能。

实例输出

整型输出：

```
fibonacci( 0 ) = 0
fibonacci( 1 ) = 1
fibonacci( 2 ) = 1
fibonacci( 3 ) = 2
fibonacci( 4 ) = 3
fibonacci( 5 ) = 5
fibonacci( 6 ) = 8
fibonacci( 7 ) = 13
fibonacci( 8 ) = 21
fibonacci( 9 ) = 34
fibonacci( 10 ) = 55
fibonacci( 20 ) = 6765
fibonacci( 30 ) = 832040
fibonacci( 35 ) = 9227465
```

双精度型输出：

```
fibonacci( 0 ) = 0.0
fibonacci( 1 ) = 1.0
fibonacci( 2 ) = 1.0
fibonacci( 3 ) = 2.0
fibonacci( 4 ) = 3.0
fibonacci( 5 ) = 5.0
fibonacci( 6 ) = 8.0
fibonacci( 7 ) = 13.0
fibonacci( 8 ) = 21.0
fibonacci( 9 ) = 34.0
fibonacci( 10 ) = 55.0
fibonacci( 20 ) = 6765.0
fibonacci( 30 ) = 832040.0
fibonacci( 35 ) = 9227465.0
```

- **7、（习题 6.45）：**

问题描述

(英文)(Recursive Greatest Common Divisor) The greatest common divisor of integers x and y is the largest integer that evenly divides both x and y. Write a recursive function gcd that returns the greatest common divisor of x and y, defined recursively as follows: If y is equal to 0, then gcd(x, y) is x; otherwise, gcd(x, y) is gcd(y, x % y), where % is the modulus operator. [Note: For this algorithm, x must be larger than y.]

（中文）（递归法求最大公约数）整数 x 和 y 的最大公约数是能同时被 x 和 y 整除的最大整数。编写一个函数 gcd()，返回 x 和 y 的最大公约数，定义递归如下：假如 y=0，gcd(x, y)=x；否则，gcd(x, y)= gcd(y, x % y)，这里的%是求模运算符。[注：对于此算法，x 必须大于 y。]

实例输出

```
Enter two integers: 30 10
Greatest common divisor of 30 and 10 is 10
```

Homework

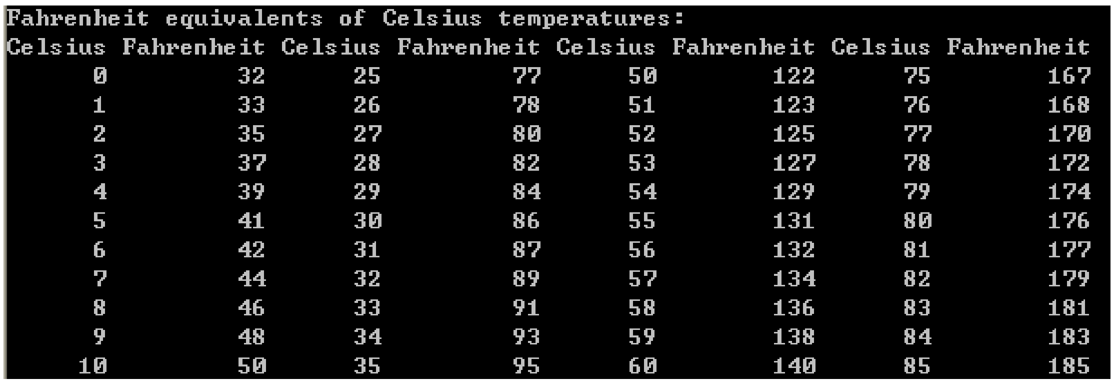
- 1、（习题 6.27）

问题描述

(英文)(Celsius and Fahrenheit Temperatures) Implement the following integer functions: Function celsius returns the Celsius equivalent of a Fahrenheit temperature. Function fahrenheit returns the Fahrenheit equivalent of a Celsius temperature. Use these functions to write a program that prints charts showing the Fahrenheit equivalents of all Celsius temperatures from 0 to 100 degrees, and the Celsius equivalents of all Fahrenheit temperatures from 32 to 212 degrees. Print the outputs in a neat tabular format that minimizes the number of lines of output while remaining readable.

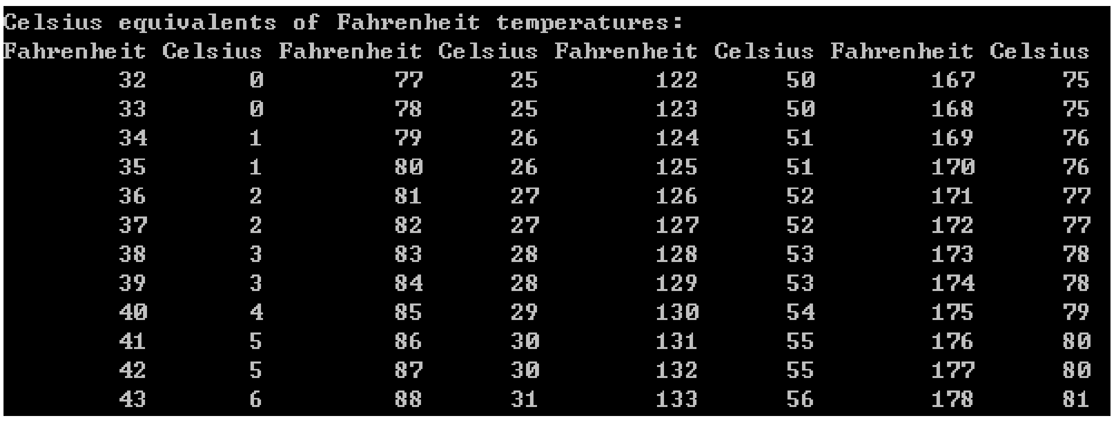
（中文）（摄氏和华氏温度）实现以下功能（整型）：摄氏函数返回与一个华氏温度等值的摄氏温度值。华氏函数返回与一个摄氏温度等值的华氏温度值。使用这些函数编写一个程序打印输出图表，图表显示与所有摄氏 0 到 100 度等值的华氏温度值和与所有华氏 32 到 212 度等值的摄氏温度值。以一种在保持可读性的情况下尽可能减少输出的行数的形式打印输出一个排列整齐的表格。

实例输出



```
Fahrenheit equivalents of Celsius temperatures:
Celsius Fahrenheit Celsius Fahrenheit Celsius Fahrenheit Celsius Fahrenheit
      0         32      25         77      50        122      75        167
      1         33      26         78      51        123      76        168
      2         35      27         80      52        125      77        170
      3         37      28         82      53        127      78        172
      4         39      29         84      54        129      79        174
      5         41      30         86      55        131      80        176
      6         42      31         87      56        132      81        177
      7         44      32         89      57        134      82        179
      8         46      33         91      58        136      83        181
      9         48      34         93      59        138      84        183
     10         50      35         95      60        140      85        185
```

…………..



```
Celsius equivalents of Fahrenheit temperatures:
Fahrenheit Celsius Fahrenheit Celsius Fahrenheit Celsius Fahrenheit Celsius
        32       0         77      25        122      50        167      75
        33       0         78      25        123      50        168      75
        34       1         79      26        124      51        169      76
        35       1         80      26        125      51        170      76
        36       2         81      27        126      52        171      77
        37       2         82      27        127      52        172      77
        38       3         83      28        128      53        173      78
        39       3         84      28        129      53        174      78
        40       4         85      29        130      54        175      79
        41       5         86      30        131      55        176      80
        42       5         87      30        132      55        177      80
        43       6         88      31        133      56        178      81
```

● 2、（习题 6.35 - 37）：

问题描述

（1）(中文)计算机在教育领域的作用越来越大，编写一个程序，帮助小学生学习乘法。用 rand 函数产生两个一位正整数，然后输入下列问题：

How much is 6 times 7?

然后学生输入答案，程序检查学生的答案。如果正确，则打印”very good”。然后提出另一个乘法问题。如果不正确，则打印″No. Please try again.″，然后让学生重复回答这个问题，直到答对。

（2）在教学中使用计算机称为计算机辅助教学(CAI)。CAI 环境中出现的一个问题是学生容易疲劳。要消除这个问题，可以改变计算机的对话来保持学生的注意力。修改练习(1)的程序，使每次学生答对时和答错时打印不同的评语。

答对时打印：

```
Very good!
Excellent!
Nice work!
Keep up the good work!
```

Responses to an incorrect answer

```
No. Please try again.
Wrong. Try once more.
Don't give up!
No. Keep trying.
```

用随机数产生器选择 1 到 4 的数，由此选择相应评语。用 switch 结构发出响应。

（3）更复杂的计算机辅助教学(CAI)系统需要监视学生在一段时间的成绩。新内容的推出通常是在学生学好旧内容之后进行的。修改（2）的程序，统计学生答对和答错的比例（每题仅给一次回答机会）。学生答完 10 题后，程序计算其答对率。如果比例不到 75%，则程序打印″Please ask your instructor for extra help″，否则输出“Nice work!”. 然后终止。

● 3、（习题 6.38 - 39）：

问题描述

编写一个猜数字游戏的程序，程序随机选择一个 l 到 1000 的数

I have a number between 1 and 1000.
Can you guess my number?
Please type your first guess.

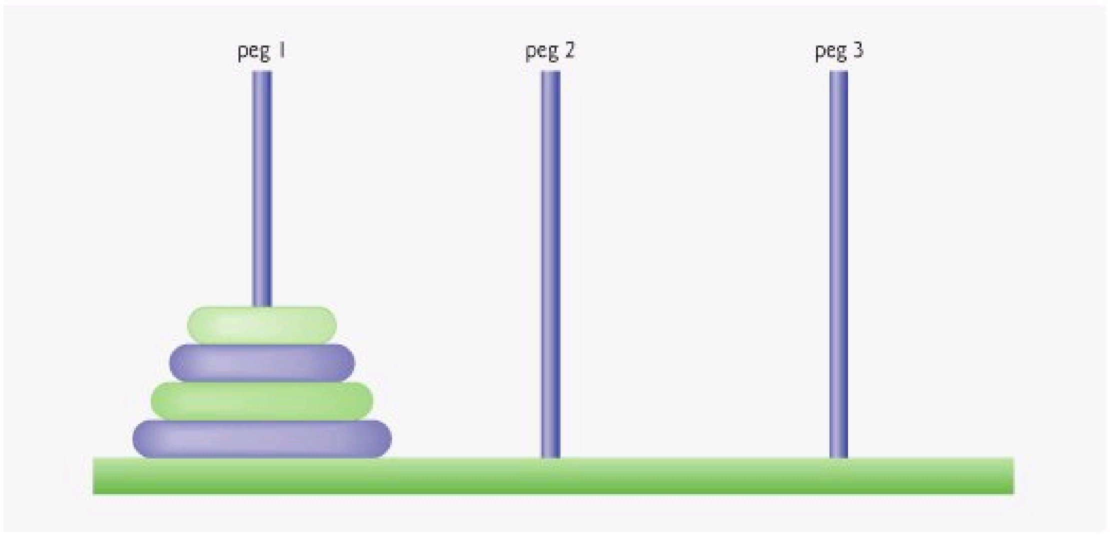
然后游戏者输入第一个结果。程序响应如下：

1. Excellent! You guessed the number!
   Would you like to play again (y or n)?
2. Too low. Try again.

3.　Too high. Try again.

如果游戏考猜错，则程序进行循环．直到猜对。程序通过 Too high 或 To low 消息帮助学生接近正确答案。说明：这个程序中采用的查找技术称为二分查找。计算游戏者已猜过的次数。如果次数值为 10 以下，则打印“Either you know the secret or you got lucky!”。如果 10 次猜中，则打印“Ahak! You know the secrete”。如果超过 10 次才猜中，则打印“You should be able to do better!” 如何在最少的次数内猜中呢？为什么 1 到 l000 的数字能在 10 次之内猜中呢？

- 4、（习题 6.42）：汉诺塔



Lab6 Array I

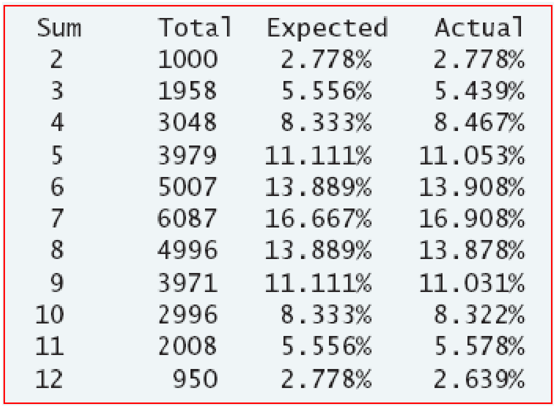
Objectivities

1. Using rand to generate random numbers and using srand to seed the random-number generator.
2. Declaring, initializing and referencing arrays.
3. The follow-up questions and activities also will give you practice:
4. Remembering that arrays begin with subscript 0 and recognizing off-by-one errors.
5. Preventing array out-of-bounds errors.
6. Using two-dimensional arrays.

Experiment

Description of the Problem

Write a program that simulates the rolling of two dice. The program should call rand to roll the first die, and should call rand again to roll the second die. The sum of the two values should then be calculated. [Note: Each die has an integer value from 1 to 6, so the sum of the two values will vary from 2 to 12, with 7 being the most frequent sum and 2 and 12 being the least frequent sums.] Figure L 7.1 shows the 36 possible combinations of the two dice. Your program should roll the two dice 36,000 times. Use a one-dimensional array to tally the numbers of times each sum appears. Print the results in a tabular format. Also, determine if the totals are reasonable (i.e., there are six ways to roll a 7, so approximately one sixth of all the rolls should be 7).



```
  Sum      Total  Expected    Actual
   2       1000    2.778%    2.778%
   3       1958    5.556%    5.439%
   4       3048    8.333%    8.467%
   5       3979   11.111%   11.053%
   6       5007   13.889%   13.908%
   7       6087   16.667%   16.908%
   8       4996   13.889%   13.878%
   9       3971   11.111%   11.031%
  10       2996    8.333%    8.322%
  11       2008    5.556%    5.578%
  12        950    2.778%    2.639%
```

Template

```
#include <iostream>
using std::cout;
using std::ios;
#include <iomanip>
using std::setw;
using std::setprecision;
using std::fixed;
using std::showpoint;
#include <cstdlib>
using std::rand;
using std::srand;
#include <ctime>
using std::time;

int main()
{
    const long ROLLS = 36000;
    const int SIZE = 13;

    // array exepected contains counts for the expected
    // number of times each sum occurs in 36 rolls of the dice
    /* Write the declaration of array exprected here. Assign an
    initializer list containing the expected values here. Use
    SIZE for the number of elements */
    int x; // first die
    int y; // second die
            /* Write declaration for array sum here. Initialize all
    elements to zero. Use SIZE for the number of elements */

    srand( time( 0 ) );

    // roll dice 36,000 times
    /* Write a for statement that iterates ROLLS times. Randomly
    generate values for x (i.e., die1) and y (i,e, die2)
    and increment the appropriate counter in array sum that
    corresponds to the sum of x and y */

    cout << setw( 10 ) << "Sum" << setw( 10 ) << "Total" << setw( 10 )
        << "Expected" << setw( 10 ) << "Actual\n" << fixed << showpoint;
    // display results of rolling dice
    for ( int j = 2; j < SIZE; j++ )
        cout << setw( 10 ) << j << setw( 10 ) << sum[ j ]
        << setprecision( 3 ) << setw( 9 )
        << 100.0 * expected[ j ] / 36 << "%" << setprecision( 3 )
        << setw( 9 ) << 100.0 * sum[ j ] / 36000 << "%\n";
    return 0; // indicates successful completion
}   // end main
```

Problem-Solving Tips

1. Remember that array subscripts always begin with zero. This is also true for each dimension of a multiple-subscripted array (which this lab does not use).

2. The actual percentage is the likelihood, based on the results of your program, that a dice roll produced a certain result. In other words, if you roll the dice 36,000 times the actual percentage will be the (number of times a result occurred / 36000) * 100.

3. The expected percentage is the statistical probability that a dice roll will produce a certain result. This can be calculated from the diagram “36 possible outcomes of rolling two dice,” shown in the problem description. For example, there is only one combination that will produce the sum of 2 and there are 36 total combinations. Therefore, the expected percentage of rolling a 2 is 1/36 or 2.778%.

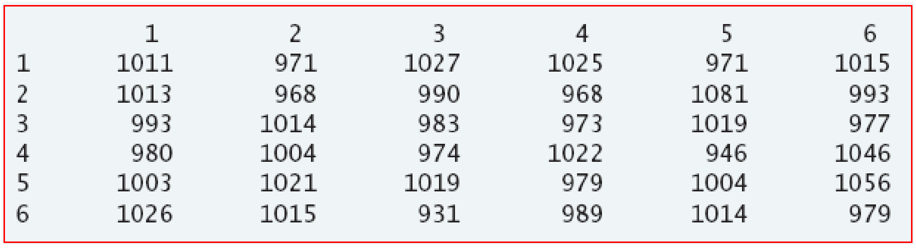
Follow-Up Questions and Activities

1. Why is the variable SIZE initialized to 13 when there are only 11 possible die-roll outcomes?

2. What happens if the < operator on line 47 of the program template is changed to <=?

3. What happens if the elements of array sum are not initialized to zero? Try running the program without initializing the array. Show your results.

4. Modify the program to use a two-dimensional array similar to the diagram in Figure L 7.1. Now, rather than counting the number of times each sum appears, increment the correct cell in the array. Print this array with the number of times each dice combination occurred. A sample output may look like the following:



```
           1         2         3         4         5         6
1       1011       971      1027      1025       971      1015
2       1013       968       990       968      1081       993
3        993      1014       983       973      1019       977
4        980      1004       974      1022       946      1046
5       1003      1021      1019       979      1004      1056
6       1026      1015       931       989      1014       979
```

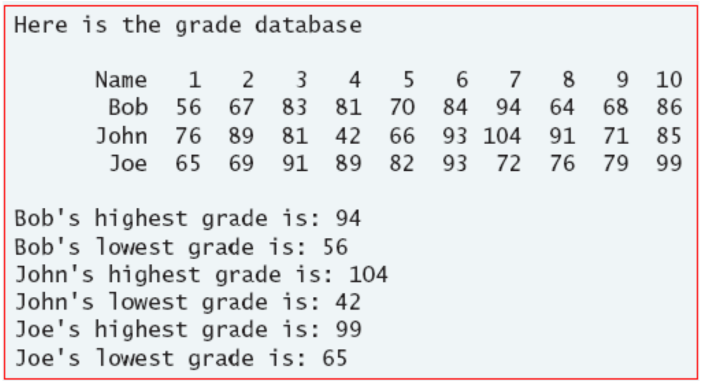
Debugging

The following program in this section does not run properly. Fix all the compilation errors so that the program will compile successfully. Once the program compiles, compare the output with the sample output, and eliminate any logic errors that may exist. The sample output demonstrates what the program’ s output should be once the program’ s code has been corrected.

```
#include <iostream>
using std::cout;
using std::endl;
#include <iomanip>
using std::setw;
#include <ctime>
const int NUM_GRADES = 10;
const int NUM_SUDENTS = 3;
int findHighest( int );
int findLowest( int * );
void printDatabase( const int [][], const char [][ 20 ] );
int main()
{
    int student1[ NUM_GRADES ] = { 0 };
    int student2[ NUM_GRADES ] = { 76, 89, 81, 42, 66, 93, 104,
        91, 71, 85, 105 };

    int student3[ NUM_GRADES ] = { 65, 69, 91, 89, 82, 93, 72,
        76, 79, 99 };
    char names[ NUM_SUDENTS ][ 20 ] = { "Bob", "John", "Joe" };
    int database[ NUM_SUDENTS ][ NUM_GRADES ];
    int i = 0;
    srand( time( 0 ) );
    // initialize student1
    for ( i = 0; i < NUM_GRADES; i++ )
        student1[ NUM_GRADES ] = rand() % 50 + 50;
    // initialize database
    for ( i = 1; i < NUM_GRADES; i++ ) {
        database[ 0 ][ i ] = student1[ i ];
        database[ 1 ][ i ] = student2[ i ];
        database[ 2 ][ i ] = student3[ i ];
    } // end for
    printDatabase( database, studentNames );
    for ( i = 0; i < NUM_SUDENTS; i++ ) {
        cout << studentNames[ i ] << "'s highest grade is: "
            << findHighest( student1 ) << endl
            << studentNames[ i ] << "'s lowest grade is: "
            << findLowest( database[ i ] ) << endl;
    } // end for
    return 0;
} // end main
// determine largest grade
int findHighest( int )
{
    int highest = a[ 0 ];
    for ( int i = 1; i <= NUM_GRADES; i++ )
        if ( a[ i ] > highest )
            highest = a[ i ];

        return highest;

} // end function findHighest

// determine lowest grade
int findLowest( int a[] )
{
    int lowest = a[ 0 ];

    for ( int i = 1; i < NUM_GRADES; i++ )
        if ( a[ i ] < lowest )
            lowest = a[ i ];

        return lowest;
        // end lowestGrade
```

```
          // output data
          void printDatabase( int a[][ NUM_GRADES ], char names[][ 20 ] )
               cout << "Here is the grade database\n\n"
               << setw( 10 ) << "Name";
          for ( int n = 1; n <= NUM_GRADES; n++ )
               cout << setw( 4 ) << n;
          cout << endl;
          for ( int i = 0; i < NUM_SUDENTS; i++ ) {
               cout << setw( 10 ) << names[ i ];
               for ( int j = 0; j < NUM_GRADES; j++ )
                    cout << setw( 4 ) << a[ i, j ];
               cout << endl;
          } // end for
          cout << endl;
}
// end printDatabase
```

Sample Output



```
Here is the grade database

      Name   1   2   3   4   5   6   7   8   9  10
       Bob  56  67  83  81  70  84  94  64  68  86
      John  76  89  81  42  66  93 104  91  71  85
       Joe  65  69  91  89  82  93  72  76  79  99

Bob's highest grade is: 94
Bob's lowest grade is: 56
John's highest grade is: 104
John's lowest grade is: 42
Joe's highest grade is: 99
Joe's lowest grade is: 65
```

Homework

1. Use a one-dimensional array to solve the following problem. A company pays its salespeople on a commission basis. The salespeople each receive $200 per week plus 9 percent of their gross sales for that week. For example, a salesperson who grosses $5000 in sales in a week receives $200 plus 9 percent of $5000, or a total of $650. Write a program (using an array of counters) that determines how many of the salespeople earned salaries in each of the following ranges (assume that each salesperson's salary is truncated to an integer amount):

a) $200–299

b) $300–399

c) $400–499

d) $500–599

e) $600–699

f) $700–799

g) $800–899

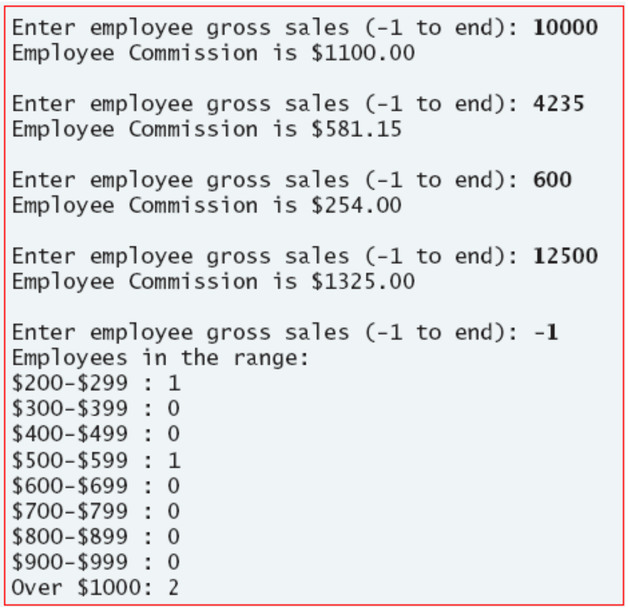
h) $900–999

i) $1000 and over

Hints:

- Calculate salary as a double. Then use static_cast< int > to truncate the salaries and convert them to integers. Divide by 100 to obtain an array index.
- Make use of the ?: operator to index the array. (What happens if the index is >= 10?)

Sample output:



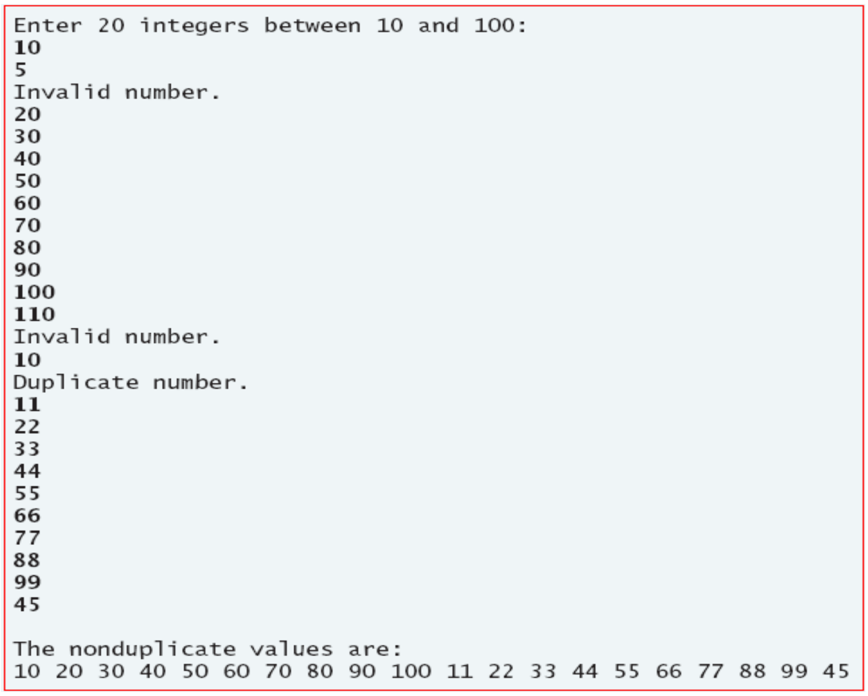
```
Enter employee gross sales (-1 to end): 10000
Employee Commission is $1100.00

Enter employee gross sales (-1 to end): 4235
Employee Commission is $581.15

Enter employee gross sales (-1 to end): 600
Employee Commission is $254.00

Enter employee gross sales (-1 to end): 12500
Employee Commission is $1325.00

Enter employee gross sales (-1 to end): -1
Employees in the range:
$200-$299 : 1
$300-$399 : 0
$400-$499 : 0
$500-$599 : 1
$600-$699 : 0
$700-$799 : 0
$800-$899 : 0
$900-$999 : 0
Over $1000: 2
```

2. Use a one-dimensional array to solve the following problem: Read in 20 numbers, each of which is between 10 and 100, inclusive. As each number is read, validate it and store it in the array only if it is not a duplicate of a number already read. After reading all the values, display only the unique values that the user entered. Provide for the “worst case” in which all 20 numbers are different. Use the smallest possible array to solve this problem.

Hints:

Compare every value input to all existing array elements. If it is a duplicate, set a flag variable to 1. This flag should be used to determine whether it is necessary to print the value. Use a counter variable to keep track of the number of elements entered into the array and the array position where the next value should be stored.

Sample output:



```
Enter 20 integers between 10 and 100:
10
5
Invalid number.
20
30
40
50
60
70
80
90
100
110
Invalid number.
10
Duplicate number.
11
22
33
44
55
66
77
88
99
45

The nonduplicate values are:
10 20 30 40 50 60 70 80 90 100 11 22 33 44 55 66 77 88 99 45
```

Lab7 Array II

Objectives

This lab was designed to reinforce programming concepts from Chapter 7 of C++ How To Program: Sixth Edi-tion. In this lab, you will practice:

- Sorting data using the bubble sort algorithm.

The follow-up question and activity also will give you practice:

- Optimizing a program to be more efficient.

Experiments

In the bubble sort algorithm, smaller values gradually “bubble” their way upward to the top of the array like air bubbles rising in water, while the larger values sink to the bottom. The bubble sort makes several passes through the array. On each pass, successive pairs of elements are compared. If a pair is in increasing order (or the values are identical), we leave the values as they are. If a pair is in decreasing order, their values are swapped in the array.

Write a program that sorts an array of 10 integers using bubble sort.

```
Data items in original order
2 6 4 8 10 12 89 68 45 37
Data items in ascending order
2 4 6 8 10 12 37 45 68 89
```

Template

```
// Lab 2: bubblesort.cpp
// This program sorts an array's values into ascending order.
#include <iostream>
```

```
using std::cout;
using std::endl;

#include <iomanip>
using std::setw;

int main()
{
    const int arraySize = 10; // size of array a
    int a[ arraySize ] = { 2, 6, 4, 8, 10, 12, 89, 68, 45, 37 };
    int hold; // temporary location used to swap array elements
    cout << "Data items in original order\n";
    // output original array
    for ( int i = 0; i < arraySize; i++ )
    cout << setw( 4 ) << a[ i ];
// bubble sort
// loop to control number of passes
/* Write a for header to loop for one iteration less than the size
of the array */
{
    // loop to control number of comparisons per pass
    /* Write a for header to iterate j from 0 and keep looping while j is less than arraySize - 1 */
    {
        // compare side-by-side elements and swap them if
        // first element is greater than second element
        /* Write an if statement to test if element j is greater than element j + 1 */
        {
            /* Write code to swap the values in element j and element j + 1, using hold as temporary
              storage */
        } // end if
    } // end for
} // end for
cout << "\nData items in ascending order\n";
// output sorted array
for ( int k = 0; k < arraySize; k++ )
    cout << setw( 4 ) << a[ k ];
cout << endl;
return 0; // indicates successful termination
} // end main
```

Fig. L 7.3 | bubblesort.cpp.

Problem-Solving Tips

1. Each “bubbling” pass through the array brings one element, the i^{th}

up to its correct position. This means that the program will require arraySize - 1 passes through the array to sort the entire array.

2. Each bubbling pass will look at each pair of adjacent elements and swap them if they are not already in
sorted order.
3. To swap two elements, the value of one element will have to be stored in a temporary storage variable while the value of the other element is placed in the first, and then the second element can be replaced with the temporary storage value.

Follow-Up Question and Activity

1. This bubble sort algorithm is inefficient for large arrays. Make the following simple modifications to improve the performance of the bubble sort:
   a) After the first pass, the largest number is guaranteed to be in the highest-numbered element of the array; after the second pass, the two highest numbers are “in place,” and so on. Instead of making nine comparisons on every pass, modify the bubble sort to make eight comparisons on the second pass, seven onthe third pass, and so on.
   b) The data in the array may already be in the proper order or near-proper order, so why make nine passesif fewer will suffice? Modify the sort to check at the end of each pass if any swaps have been made. If none have been made, then the data must already be in the proper order, so the program should terminate. If swaps have been made, then at least one more pass is needed.

Program Challenge

A prime integer is any integer greater than 1 that is evenly divisible only by itself and 1. The Sieve of Eratosthenes is a method of finding prime numbers. It operates as follows:

1. Create an array with all elements initialized to 1 (true). Array elements with prime subscripts will remain. All other array elements will eventually be set to zero. You will ignore elements 0 and 1 in this exercise.
2. Starting with array subscript 2, every time an array element is found whose value is 1, iterate through the remainder of the array and set to zero every element whose subscript is a multiple of the subscript for the element with value 1. For array subscript 2, all elements beyond 2 in the array that are multiples of 2 will be set to zero (subscripts 4, 6, 8, 10, etc.); for array subscript 3, all elements beyond 3 in the array that are multiples of 3 will be set to zero (subscripts 6, 9, 12, 15, etc.); and so on.

When this process is complete, the array elements that are still set to one indicate that the subscript is a prime number. These subscripts can then be printed. Write a program that uses an array of

1000 elements to determine and print the prime numbers between 2 and 999. Ignore elements 0 and 1 of the array.

Homework:

7.32, 7.37

Lab8 Pointers and Pointer-based Strings

Objectives

- To understand the concept of pointer, master pointer-based indirect organization method of data.
- To master the basic of declare and use pointer in C++, the basic operation of pointer.
- To master the relationship between pointer and array, the pointer-based array operation.
- To master the relationship between pointer and string, the pointer-based string operation.
- To master the use of standard string library fuction.
- To master the relationship between pointer and function, the pointer-based function operation.

Experiments

1、To run the following program and analysis its result.

```
#include <iostream>
using std::cout;
using std::endl;

int main()
{
   int a[]={1,3,5,7,9};
   int *p[]={a,a+1,a+2,a+3,a+4};
   int *p1=a;

   cout<<"Test 1:-------------------------------"<<endl;
   cout<<a[4]<<"\t"<<*(a+2)<<"\t"<<*p[1]<<**(p+1)<<"\t"<<**(p+1)+a[2]<<"\t"
         <<*(p+4)-*(p+0)<<"\t"<<*(a+3)%a[4]<<endl;

   cout<<"Test 2:-------------------------------"<<endl;
   cout<<*(++p1)<<"\t"<<*(p1+2)<<"\t"<<*(++++p1)<<*(++p1=88)<<"\t"<<endl;

   cout<<"Test 3:-------------------------------"<<endl;
   cout<<sizeof(p1)<<"\t"<<sizeof(*p1)<<"\t"<<&p1<<"\t"<<*p1<<endl;
}
```

2、To declare an array and input 10 integers into it. Then sort and output the array by pointer-based operation.

3、To declare a function to swap two integer as following every prototype, and analysis carefully their executing.

void swap(int a, int b); // declare a local identifier *temp*
void swap(int a, int b); // declare a local identifier *temp**
void swap(int a, int* b);* // declare a local identifier *temp*
void swap(int a, int* b);* // declare a local identifier *temp**
void swap(int& a, int& b); // declare a local identifier *temp*

4、To declare a function to get the sum of two integer as following every prototype, and analysis carefully their executing.

int getsum(int a, int b); // declare a local identifier *temp*, return *temp*
int swap(int a, int b);* // declare a local identifier *temp*, return the **address** of *temp*
void swap(int a, int b); // declare a local identifier *temp**, return *temp*
void swap(int a, int b); // declare a local identifier *temp**, return the **content** of *temp*
void swap(int a, int b); // declare a local identifier *temp&*, return *temp*

5、To write a function *strcpy(char*s1, const char* s2)* that copies string *s2* into the **character array** *s1*. (see Fig8.30 in p341)

6、To write a function *strcat(char*s1, const char* s2)* that appends the string *s2* to *s1*. (see Fig8.30 in p341)

7*、At first, we declare a 3-by-5 two-dimensional array. Then it and output result by pointer-based operation.

<u>**Homework:**</u>

Ex8.36, Ex8.38*, Ex8.46