C++ CHARACTER INPUT & OUTPUT

C++		C	
Input	Output	Input	Output
cin	cout	scanf	printf
cin.getline		gets	

Character Input with **cin** and **cin.getline**

and Character Output with **cout**

Defensive Programming is also covered

Stream I/O

The most common way for a C++ program to input from a keyboard and output to the display is to use **cin** and **cout** which stand for console-in and console-out.

```
int a;
cout << "Enter a number: ";
cin  >> a;
cout << "The number squared is " <<  a*a  << endl;
```

NOTE: Operating systems like Linux can use pipes and redirection to cause stdin and stdout to use other devices or even other programs

Use **endl** in C++ to move the cursor to the next line on the display. The word **endl** means 'end line'. The last character of **endl** is a small-L not the number-1.

cin and **cout**

cin stands for Console-Input

cout stands for Console-Output

They are pronounced as SEE-in and SEE-out. You could also say console-in and console-out, but never SIN or KOUT, otherwise people will think that you are an uninformed newbie  and be accused of a grievous sin. 

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cin and **cout** Know the Data Type

```
int a;          // the variable a holds an integer
                // it can only hold whole numbers
double b;       // the variable b holds a floating-point
                // value with digits past the decimal
char c;         // the variable c holds only a single
                // character
string d;       // the variable d holds a string of
                // string of multiple characters
```

User defined data types can also be used with cin and cout by implementing a **Friend** function. This will be covered much later.

>> The INSERTION Operators <<

C++ uses the insertion operators >> and << with cin and cout. Look at the way the arrows are facing with respect to the console and the variable.

```
int  x;
cin  >> x;    // read the keyboard, put the value into x
cout << x;  // get the value from x, send to the display
```

using namespace std;

It is not required to place **using namespace std;** near the top of your program. The other option is to identify the namespace before each **cin** or **cout** like this:

```
std::cout << "Enter a number ";
std::cin  >> x;
```

The double-colon :: is called the scope resolution operator.

C++ CHARACTER INPUT

C++		C	
Input	Output	Input	Output
cin	cout	scanf	printf
cin.getline	Formatted	gets	puts

This part of the discussion covers
C++ Character Input with **cin** and **cin.getline**
Defensive Programming is also covered

How Does **cin** work?

- **cin** reads a stream of data from the keyboard into a variable
- A sample program demonstrates how **cin** can read three numbers from the keyboard, add them together and display the sum
- **cin** uses Whitespace characters to separate one piece of data from the next piece

Reading one or more pieces of data

cin can read one or more pieces of data at a time.

```
#include <iostream>
#include <string>
using namespace std;

int main()
{
    int empID;
    string name;
    cout << "Enter ID# and last name: ";
    cin  >> empID;
    cin  >> name;
    cout << "Hello " << name << " " << empID;
    cout << endl;
    return 0;
}
```

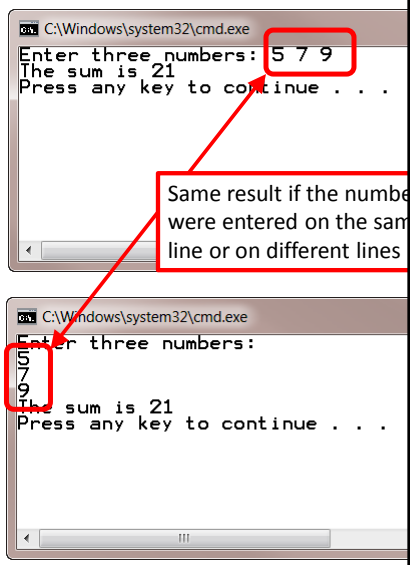
Separate cin statements are used to read into empID and name

```
#include <iostream>
#include <string>
using namespace std;

int main()
{
    int empID;
    string name;
    cout << "Enter ID# and last name: ";
    cin  >> empID >> name;
    cout << "Hello " << name << " " << empID;
    cout << endl;
    return 0;
}
```

One cin statement is used to read into empID and name

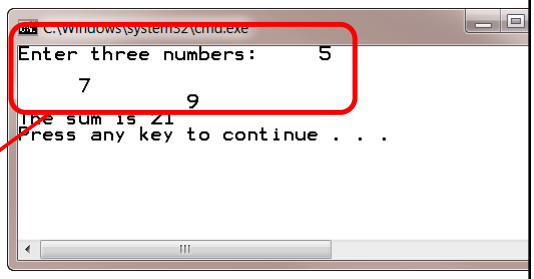
Sample Program – Add 3 Numbers

```
#include "stdafx.h"
#include <iostream>
using namespace std;

int main(int argc, char* argv[])
{
    // declare the variables
    int a;
    int b;
    int c;
    int sum;

    // input
    cout << "Enter three numbers: ";
    cin  >> a >> b >> c;
   // process
    sum = a + b + c;
    // output
    cout << "The sum is " << sum << endl;

    return 0;
}
```



Whitespace

```
// declare the variables
int a, b, c, sum;

// input
cout << "Enter three numbers: ";
cin  >> a >> b >> c;
```



□ □ □ □ □ □ 5\n\t 7 \n □ □ □ \t 9 \n

Ignore the leading spaces then read the 5 into the variable **a**

Ignore the Enter and Tab keys then read the 7 into the variable **b**

Ignore the Enter spaces and Tab then read the 9 into the variable **c**

□ represent the space bar being pressed
\n represent the Enter key being pressed
\t represent the Tab key being pressed

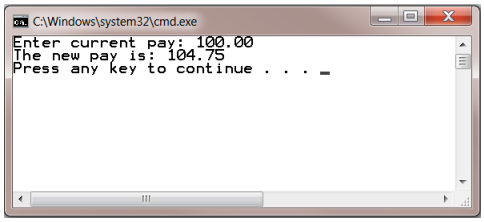
The PROMPT Message

When reading data from the keyboard, it is necessary to display a message on the screen asking for the data and identifying what type of data is expected. This is called a **prompt**. If no prompt is provided, the cursor on the screen will just blink and the user will have no idea of what to do or may think that the program just crashed.

The PROMPT message

The prompt is part of the input process.

```
#include <iostream>
using namespace std;

const double PERCENT_RAISE  = 4.75;

int main()
{
    double currentPay;
    double newPay;
    // input the current pay
    cout << "Enter current pay: ";
    cin  >> currentPay;
    // processing
    newPay = currentPay + currentPay*PERCENT_RAISE/100;
    // output
    cout << "The new pay is: " << newPay << endl;
    return 0;
}
```



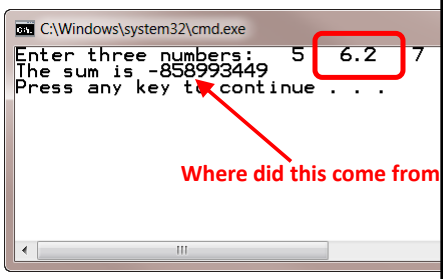
Unexpected Inputs and Defensive Programming

- What happens if **cin** is expecting one data type and something else is input?
- How do we find out what **cin** is actually reading?
- How do we detect an error from **cin** and what should be done if an error occurs?

Unexpected Data

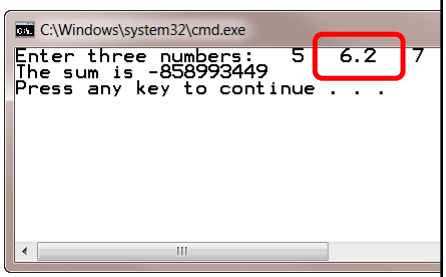
```
#include "stdafx.h"
#include <iostream>
using namespace std;

int main(int argc, char* argv[])
{
    // declare the variables
    int a;
    int b;
    int c;
    int sum;

    // input
    cout << "Enter three numbers: ";
    cin  >> a >> b >> c;
    // process
    sum = a + b + c;
    // output
    cout << "The sum is " << sum << endl

    return 0;
}
```

cin is expecting to input integers



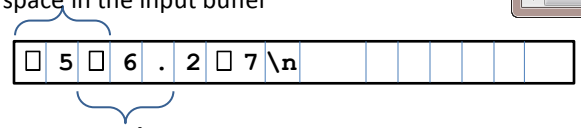
cin fails with wrong data

```
// declare the variables
int a, b, c, sum;

// input
cout << "Enter three numbers: ";
cin  >> a >> b >> c;
```



READ INTO **a**

Ignore leading space, read the 5, stop at the space and put 5 into **a** leave the space in the input buffer



READ INTO **b**

Ignore leading space, read the 6, stop at the period and put 6 into **b** leave the period in the input buffer

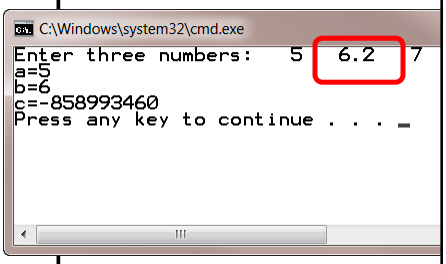
READ INTO **c**

cin is expecting to read into an integer and sees the period that was left in the input buffer. **cin** can't put anything into **c**. Whatever garbage was in memory is still in **c**

␣ represent the space bar being pressed
\n represent the Enter key being pressed

a) Use code to display the values

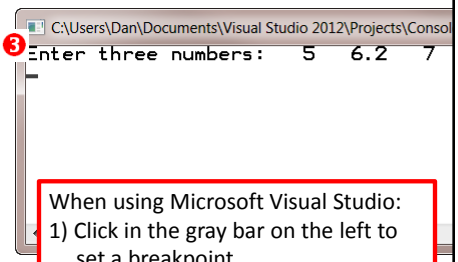
```
int main(int argc, char* argv[])
{
    // declare the variables
    int a, b, c;

    // input
    cout << "Enter three numbers:
    cin  >> a >> b >> c;
    // output
    cout << "a=" << a << endl;
    cout << "b=" << b << endl;
    cout << "c=" << c << endl;

    return 0;
}
```



cin read the 5 into the variable **a**, then cin read the 6 into the variable **b**, then when cin went to read into the variable **c** it saw the decimal point. Integers are whole numbers. No decimals allowed. Since the variable **c** was not initialized, whatever garbage was in its memory location is what was used.

b) Use Debug to display the values

```
5  #include <iostream>
6  using namespace std;
7
8  int main(int argc, char* argv[])
9  {
10     // declare the variables
11     int a;
12     int b;
13     int c;
14     int sum;
15
16     // input
17     cout << "Enter three numbers: ";
18     cin  >> a >> b >> c;
19   // process
20     sum = a + b + c;
21     // output
22     cout << "The sum is " << sum << endl
23
24     return 0;
25 }
```



When using Microsoft Visual Studio:
1) Click in the gray bar on the left to set a breakpoint
2) Use Debug/Start (F5) to run the program
3) Enter the numbers. The program will pause at the breakpoint
4) Hover the mouse over each of the variables to display their values

Possible Solutions

Solution #1 – Initialize the variables to 0 to prevent weird numbers from showing, but this does not stop wrong answers from being displayed. **BAD Solution**

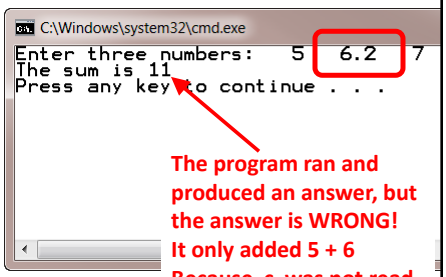
Solution #2 – change the definition of the variables from type **int** to type **double**. This will allow the **6.2** to be read without an error, but the program will still fail if the user inputs a non-numeric character such as **X**. This is NOT a complete solution. **Poor Solution**

Solution #3 – Use **cin.fail( )** to determine if cin was not able to input all the data that was entered. **GOOD**

Solution #4 – Use a **Try…Catch** block to detect and process an input error. **GOOD**

Solution #1 - Initialize the Variables

```
#include "stdafx.h"
#include <iostream>
using namespace std;

int main(int argc, char* argv[])
{
    // declare the variables
    int a = 0;
    int b = 0;
    int c = 0;
    int sum = 0;

    // input
    cout << "Enter three numbers: ";
    cin  >> a >> b >> c;
    // process
    sum = a + b + c;
    // output
    cout << "The sum is " << sum << endl;

    return 0;
}
```



The program ran and produced an answer, but the answer is WRONG! It only added 5 + 6 Because c was not read. cin stopped trying to read c when it saw the decimal point.

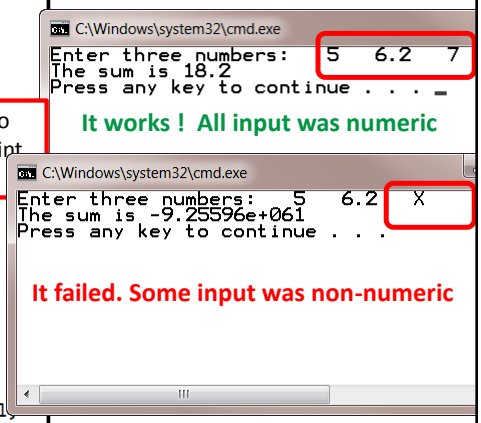
cin is expecting to input integers

Not a good solution

Solution #2 – **double** Data Type

```
#include <iostream>
using namespace std;

int main(int argc, char* argv[])
{
    // declare the vari
    double a;
    double b;
    double c;
    double sum;

    // input
    cout << "Enter three numbers: ";
    cin  >> a >> b >> c;
    // process
    sum = a + b + c;
    // output
    cout << "The sum is " << sum << endl;
    return 0;
}
```

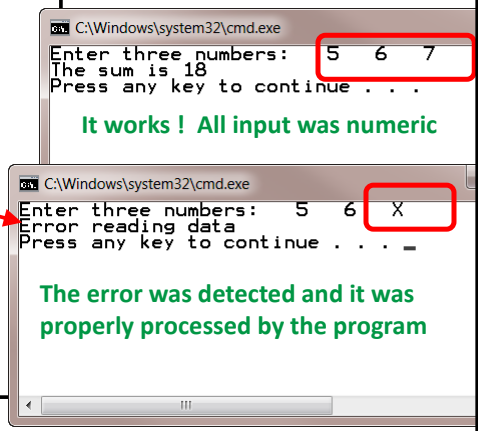
cin is expecting to input floating point numbers



Not a good solution

Solution #3 – **cin.fail( )** detects an error

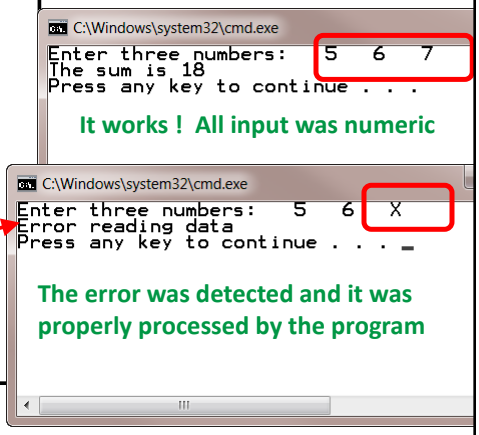
```
// input
cout << "Enter three numbers: ";
cin  >> a >> b >> c;
// process
if (cin.fail() )
{
    cout << "Error reading data" << endl;
    return 1;
}
else
{
    sum = a + b + c;
    // output
    cout << "The sum is " << sum << endl;
}
return 0;
```



This is a good solution

Solution #4 – Use a **Try…Catch** block

```
try
{
    // input
    cout << "Enter three numbers: ";
    cin  >> a >> b >> c;
    // process
    sum = a + b + c;
    // output
    cout << "The sum is " << sum << endl;
}
catch (int errID)
{
    cout << "Error reading data" << endl;
    return 1;
}
return 0;
```



The input, normal processing and output is placed in a **try** block. Any errors are processed in the **catch** block.

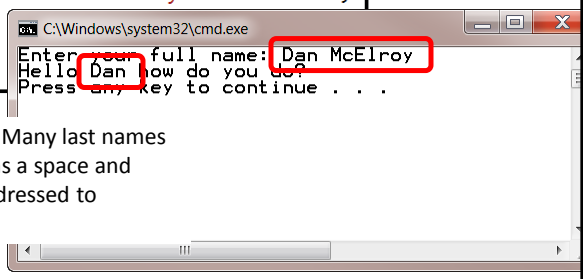
This is a good solution

cin.getline(…)

Use **cin.getline(…)** to read a full line of text without stopping each time some whitespace is detected.

cin stops at whitespace
cin.getline does not

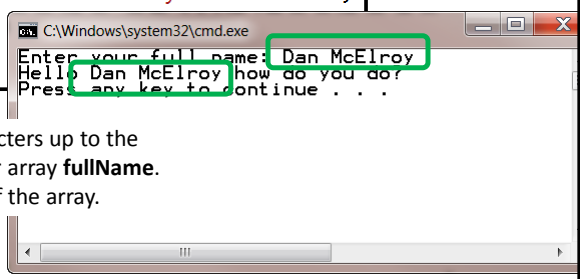
```
#include <iostream>
using namespace std;

int main(int argc, char* argv[])
{
    // declare the variables
    char fullName[101]; // room for 100 characters

    cout << "Enter your full name: ";
    cin  >> fullName;
    cout << "Hello " << fullName << " how do you do?" << endl;

    return 0;
}
```



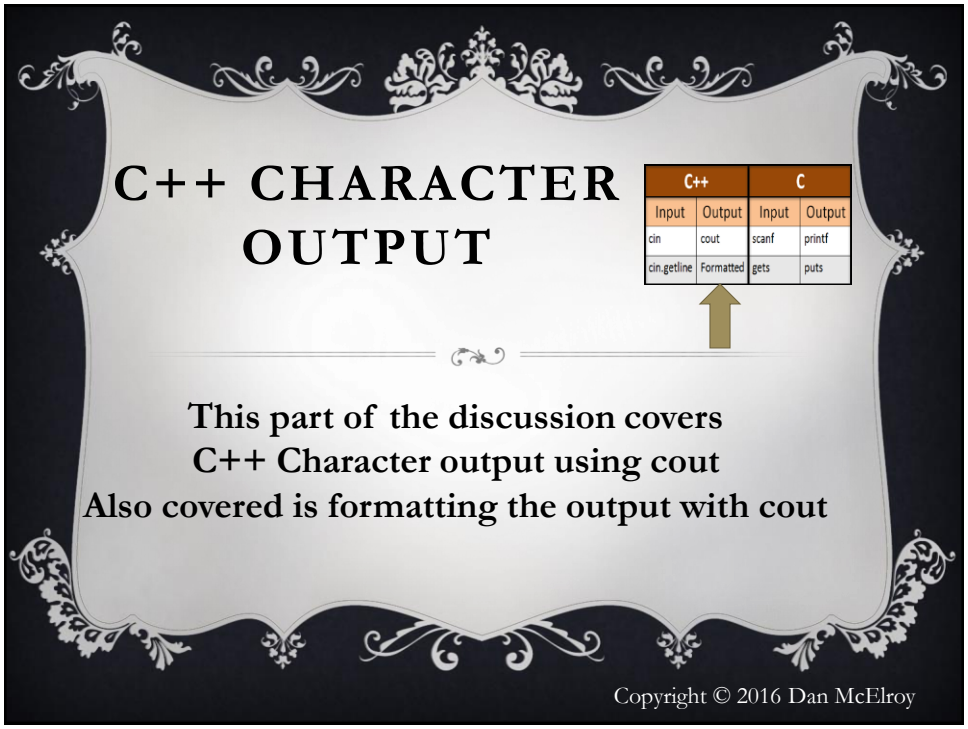
Anything after a space is lost by cin. Many last names have spaces. Sometimes **McElroy** has a space and becomes **Mc Elroy** so letters get addressed to **Mr. Elroy** instead of **Mr. Mc Elroy**

cin stops at whitespace
cin.getline does not

```
#include <iostream>
using namespace std;

int main(int argc, char* argv[])
{
    // declare the variables
    char fullName[101]; // room for 100 characters

    cout << "Enter your full name: ";
    cin.getline(fullName, 101);
    cout << "Hello " << fullName << " how do you do?" << endl;

    return 0;
}
```



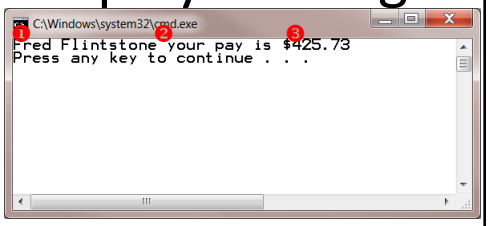
By using **cin.getline** all of the characters up to the Enter key are read into the character array **fullName**. **cin.getline** needs to know the size of the array.



cout

cout can output one or more pieces of data to the display console. Each piece of data is separated by the << insertion operator. The **endl** is used to move the cursor to the next line on the screen. NOTE: the last character in **endl** is a small-L, not the number-1. **endl** stands for END-Line.

cout Example – Display 4 Things




```
#include <iostream>
using namespace std;

int main()
{
    char name[] = "Fred Flintstone";
    double pay = 425.73;

    cout << name << " your pay is $" << pay << endl;
    return 0;
}
```

Provide a space between the name and the paycheck

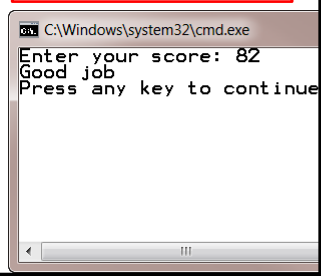
Move the cursor to the next line

cout Example – Prompt Message

```
#include <iostream>
using namespace std;

int main()
{
    int score;
    const int PASSING_SCORE = 70;

    cout << "Enter your score: ";
    cin  >> score;
    if (score >= PASSING_SCORE)
        cout << "Good job" << endl;
    else
        cout << "Try again" << endl;
    return 0;
}
```

A space is provided before the closing quote " so that the user won't be typing right next to the prompt message.

The endl was not included on this line so that the user's input would be on the same line as the prompt message.



Formatted Output with **cout**

Use the methods that are provided by **iomanip** to format output using **cout**. Depending on the data type, the following things can be done

- Set field width
- Left-justify
- Right-justify
- Center
- Set number of digits past the decimal
- Set fill character
- Set base

#include <iomanip>

Field modifiers	Example
Set the width of the field	<< setw(10)
Left justify	<< left
Right justify (default)	<< right
Fill characters	<< setfill('*')

Display integers	Example
Display as decimal (default)	<< dec
Display as octal	<< oct
Display as hex	<< hex
Set to any base	<< setbase(8)
Display **A-F** instead of **a-f**	<< uppercase

Display float numbers	Example
Number of digits past decimal	<< setprecision(2)
Fixed point notation (default)	<< fixed
Scientific notation	<< scientific
Show the decimal point even if the digits past the decimal are all zeros	<< showpoint

cout Formatting Example

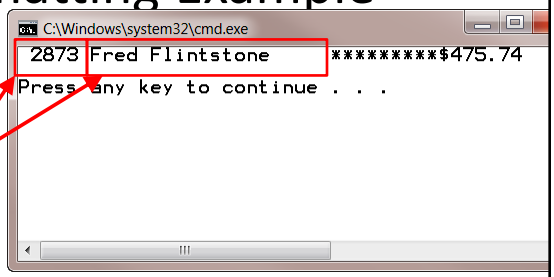
```
#include <iostream>
#include <iomanip>
using namespace std;

int main()
{
    int ID = 2873;
    double pay = 475.739;
    char name[] = "Fred Flintstone";

    cout << setw(5) << ID << " "  // space before name
         << setw(20) << left << name
         << setw(10) << setfill('*') << fixed << right
         << setprecision(2) << showpoint << '$' << pay
         << endl << endl;
}
```

#include <iomanip> is required to do formatting with cout

There are multiple lines in this **cout** statement. The **cout** statement does not end until the semicolon ; is reached

cout Formatting Example

```
#include <iostream>
#include <iomanip>
using namespace std;

    double pay = 475.739;
    char name[] = "Fred Flintstone";

    cout << setw(5) << ID << " "  // space before name
         << setw(20) << left << name
         << setw(10) << setfill('*') << fixed << right
         << setprecision(2) << showpoint << pay
         << endl << endl;
}
```



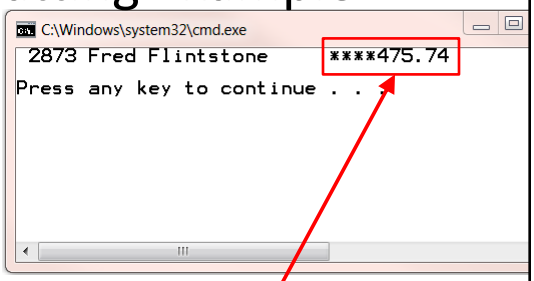
The **ID** is 5 columns wide and right-justified. The **name** is 20 columns wide and left-justified.

cout Formatting Example

```
#include <iostream>
#include <iomanip>
using namespace std;
```

The **pay** is 10 columns wide, with 2 digits past the decimal and right-justified. Asterisks * fill any unused spaces. A dollar-sign $ is placed before **pay** is displayed

```
    cout << setw(5) << ID << " "  // space before name
         << setw(20) << left << name
         << setw(10) << setfill('*') << fixed << right
         << setprecision(2) << showpoint << '$' << pay
         << endl << endl;
}
```



Creating a blank line - Example

```
#include <iostream>
#include <iomanip>
using namespace std;
```

The first **endl** moves the cursor off the line with the ID, name and pay to the next line. The second **endl** creates a blank line.

```
    char name[] = "Fred Flintstone";

    cout << setw(5) << ID << " "  // space before name
         << setw(20) << left << name
         << setw(10) << setfill('*') << fixed << right
         << setprecision(2) << showpoint << '$' << pay
         << endl << endl;
}
```