



Al-Ameen University
College of Engineering

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Lecture ()

Structured Programming

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Lecture 4

1 Statements:

A statement in a computer carries out some action. There are three types of statements used in C++; they are expression statement, compound statement and control statement.

| Expression statement | Compound statement | Control statement |
|--------------------------------|---|--|
| <code>x=y; sum=x+y;</code> | <code>{ a=b+c; x=x*x; y=a+x; }</code> | <code>If (a>b) { a=l; k=a+1; }</code> |

2 Getting Started with C++:

The skeleton of a typical C++ program structure is given below:

Program heading

Begin

Type or variable declaration

Statements of operation

Results

end

The keyboard and screen I/O instructions in C++ are:

(a): COUT/ display an object onto the video screen:

Cout<<var.1<<var2<<...<<var.n;

(b): Cin/ It is used to read an object from a standard input device (keyboard):

Cin>>var.1>>var.2>>...>>var.n;

To begin learning C++ let's examine our first C++ Program:

Example 1

```
#include<iostream.h>
void main( )
{
    // A program to print welcome
    cout << "Welcome";
}
```

Output:

Welcome

- ✓ **#include<iostream.h>** this line is for pre-processor directive. Any begins with # is processed before the program is compiled. C++ programs must be start with #include.

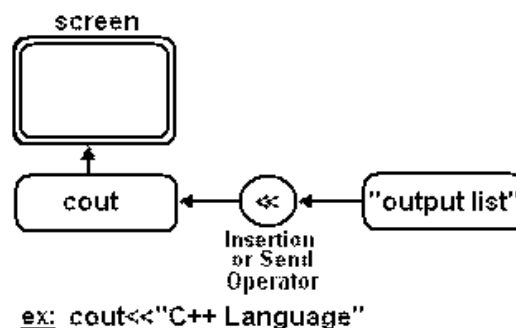
Every group of related functions is stored in a separate library called (header file).To use the *cin* and *cout*, must include the header file *iostream*.

- ✓ **main(),** is the name of C++ function. Every C++ program must have a function called main.

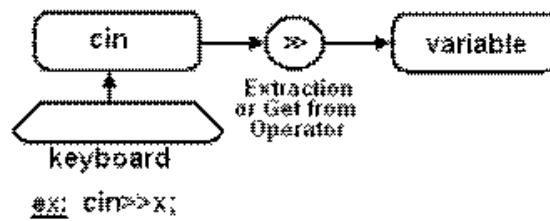
- ✓ **void,** is the return type of the main function. When the return type of a function is void, this function will not passes back any value to the calling function.

Some programmers use *int* as a return type for the main function, in this case a ***return(0)*** statement must be written as a last statement of the main function-body.

- ✓ **{,** introducing the statements that define the function.
- ✓ **},** indicates the end of the statements in the function.
- ✓ **//,** text after these symbols is a comment. It does not affect the program code, and compilers normally ignore it.
- ✓ **cout,** the input stream object. It passes the characters quotes (") to the terminal screen.



- ✓ **cin,** the input stream object. It reads the input values from the keyboard.



- ✓ <<, the stream insertion operator (or send operator).
- ✓ >>, the stream extraction operator (or get from operator).
- ✓ ;, semicolon, the terminator of every C++ statement.

The **endl** is used in c++ to represent a new line, as shown in the following example:

Example 2

```
#include<iostream.h>
void main( )
{
    cout << "hallow" << endl;
    cout << "students";
}
```

Output:

```
hallow
students
```

The **\n** is a special escape code, also used in C++ to represent a new line, as shown in the following example:

Example 3

```
#include<iostream.h>
void main( )
{
    cout << "hallow \n";
    cout << "students";
}
```

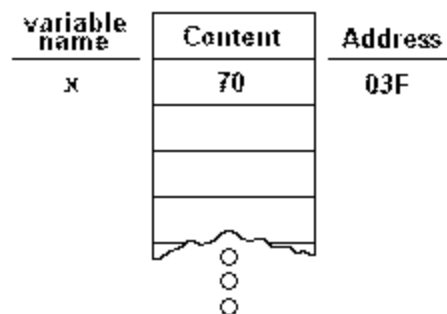
Output:

```
hallow
students
```

3 Variables Declaration:

A declaration is a process of naming the variables and their statements datatypes in C++. C++ allows declaration of the variables before and after executable statements. A variable is an object that may take on values of the specified type.

Also ,a variable is a location in the computer's memory where a value can be stored for later use by the program. Variables are like buckets that hold data. These data buckets are really locations in the computer's memory.



The variable must be declared by specifying the datatype and the identifier.

```
datatype id.1, id2, ..., idn;
```

A variable defined by stating its type, followed by one or more spaces, followed by the one or more variable names separated by commas, then followed by semicolon. For example:

```
unsigned short int X;  
float Y;  
char A, a, c;
```

Note: C++ does distinguish between above *A* and *a* variables (C++ is case-sensitive).

Example 4



The following program reads three different inputs and outputs it.

```
#include<iostream.h>
void main()
{
    int num=3;
    cout << "number="<<num<<"\n";
    char ch='a';
    cout << "character="<<ch<<"\n";
    float fa=-34.45;
    cout<<"real number="<<fa<<"\n";
}
```

Output:

```
Number=3
Character=a
Real number=34.45
```

Example 5



The following program reads three different inputs and outputs it.

```
#include<iostream.h>
void main()
{
    int n; float f; char c;
    cout << "input integer number:";
    cin>>n;
    cout<<endl;

    cout << "input decimal number:";
    cin>>f;
    cout<<endl;

    cout << "input character:";
    cin>>c;
}
```

Output:

```
input integer number: 5
input decimal number: 4.2
input character: A
```

4 Constants:

Like variables, constants are data storage locations. Unlike variables, and as the name implies, constants don't change.

```
const int myage=23;
const double pi=3.14;
const float salary=20.5;
```

Example 6

 Write a program that reads the radius of a circle, then computes and outputs its area.

```
#include<iostream.h>
void main( )
{
    const float pi = 3.14;
    int r; float c;
    cout << "enter the radius of circle:";
    cin>>r;
    cout<<endl;
    c = r * r * pi;
    cout << "the area of circle:" << c;
}
```

Output:

```
enter the radius of circle: 5
the area of circle: 78.5
```

Example 7

 The following program computes the arithmetic operators.

```
#include<iostream.h>
void main( )
{
    int a,b,sum,sub,mul,div;
    cout << "enter any two numbers<<endl;
    cin>> a>>b;
    sum=a+b;
    sub=a-b;
    mul=a*b;
    div=a/b;
    cout<<"a="<<a<<"b="<<b<<"sum="<<sum<<endl;
    cout<<"sub="<<sub<<endl;
    cout<<"mul="<<mul<<endl;
    cout<<"div="<<div<<endl;
}
```

Output:

```
Enter any two numbers
10 20
A=10 b=20 sum=30
Sub=-10
Mul=200
Div=0
```

Example 8



The following program computes different division operators.

```
#include<iostream.h>
void main( )
{
    int x, y, z, r;
    x= 7 / 2;
    cout << "x=" << x << endl;
    y=17/(-3);
    cout << "y=" << y << endl;
    z=-17/3;
    cout << "z=" << z << endl;
    r=-17/(-3);
    cout << "r=" << r << endl;
}
```

Output:

```
x= 3
y= -5
z= -5
r= 5
```

The modulus operator “%” is used with integer operands (int, short, long, unsigned). It can’t be used with float or double operands.

Example 9

```
#include<iostream.h>
void main( )
{
    int y1, y2;
    y1 = 8 % 3;
    y2 = -17 % 3;
    cout << "y1=" << y1 << endl;
    cout << "y2=" << y2 << endl;
}
```

Output:

```
y1=2
y2=-2
```


Lecture 5

1 Examples of order evaluation:

Example 1:

Write the following equation as a C++ expression:

$$f = \frac{a + b + c + d + e}{10}$$

Solution:

`f = (a + b + c + d + e) / 10;`

Note: the parentheses here are required because division has higher precedence than addition.

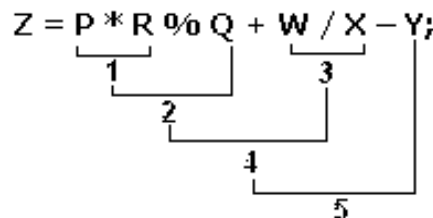
Example 2:

State the order of evaluation for the following expression:

`Z = P * R % Q + W / X - Y;`

Solution:

1. *
2. %
3. /
4. +
5. -



Example 1



Write C++ program to perform the above equation:

```
#include<iostream.h>
void main()
{
    int Z, P, R, Q, W, X, Y;
    cout << "enter P:"; cin >> P;
    cout << "enter R:"; cin >> R;
    cout << "enter Q:"; cin >> Q;
    cout << "enter W:"; cin >> W;
    cout << "enter X:"; cin >> X;
    cout << "enter Y:"; cin >> Y;
    Z = P * R % Q + W / X - Y;
    cout << "the result=" << Z;
```

2 The "math.h" Library:

The "math.h" library contains the common mathematical function used in the scientific equations.

| Common function from math.h library: | |
|--------------------------------------|----------------|
| Mathematical Expression | C++ Expression |
| e^n | Exp(x) |
| $\text{Log}(x)$ | Log10(x) |
| $\text{Ln}(x)$ | Log(x) |
| $\text{Sin}(x)$ | Sin(x) |
| x^n | Pow(x,n) |
| \sqrt{x} | Sqrt(x) |

Example:

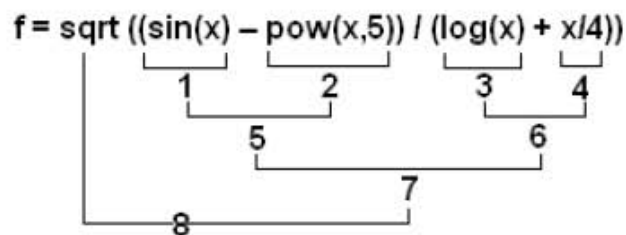
Write the following equation as a C++ expression and state the order of evaluation of the binary operators:

$$f = \sqrt{\frac{\sin(x) - x^5}{\ln(x) + \frac{x}{4}}}$$

Solution:

`f = sqrt ((sin(x) - pow(x,5)) / (log(x) + x/4))`

Order of evaluation:



Exercise:

Write the following equation as a C++ expression and state the order of evaluation of the binary operators:

$$z = \sqrt{\frac{x^2 y - 3 \sin(x)}{\tan x^3 + x^3 / y}}$$

Solution: ?

The ++ and - - operators can be written either before the variable (prefix notation) or after the variable (postfix notation) as in the following:

| | | |
|-------------------|------|--|
| Prefix notation: | ++ X | X is incremented before its value is taken or returned to current statement. |
| Postfix notation: | X ++ | X is incremented after its value is taken or returned to current statement. |

The difference between the Prefix and Postfix notations:

Prefix notation

```
int y;
int x = 7;
cout<< ++x <<endl;
y=x;
cout<<y;
```

Output:

8
8

Postfix notation

```
int y;
int x = 7;
cout<< x++ <<endl;
y=x;
cout<<y;
```

Output:

7
8

3 Manipulator Functions:

They are special stream functions that change certain characteristics of the input and output.

(a) Endl: Generate a carriage return or line feed character.

 Cout << "a" << endl;

(b) Setbase: It is used to convert the base of one numeric value into a nother base

 Dec(base 10), hex(base 16), oct(base 8)

Example 2

 Write C++ program to convert a base of a number:

```
#include<iostream.h>
void main( )
{
    int value;
    cout << "enter number:"; cin >> value;
    cout << "Decimal base="<<dec<<value<<endl;
    cout << "Hexadecimal base="<<hex<<value<<endl;
    cout << "Octa base="<<oct<<value<<endl;
}
```

| |
|--------------------|
| Enter number |
| 10 |
| Decimal base=10 |
| Hexadecimal base=a |
| Octal base=12 |

When using setbase the statement will be:

```
Cout<<"Decimal base="<<setbase(10);
```

```
Cout<<value<<endl;
```

(c) Setw: It is used to specify the minimum number of character positions on the O/P field a variable will consume: **setw(int w)**

Example 3



Write C++ program to use tab:

```
#include<iostream.h>
#include<iomanip.h>
void main( void)
{
    int a,b;
    a=200;
    b=300;
    cout<<a<<'\'<<b<<endl;
}
```

| |
|-----------|
| 200 300 |
|-----------|

Example 4



Write C++ program to use setw:

```
#include<iostream.h>
#include<iomanip.h>
void main( void)
{
    int a,b;
    a=200;
    b=300;
    cout<<setw(5)<<a<<setw(5)<<b<<endl;
    cout<<setw(6)<<a<<setw(6)<<b<<endl;
}
```

| |
|-----------|
| 200 300 |
| 200 300 |

(d) Setfill: It is used to specify a different character to fill the unused field width of the value. **Setfill(char f)**

Example 5

 Write C++ program to use setfill:

```
#include<iostream.h>
#include<iomanip.h>
void main( void)
{
    int a,b;
    a=200;
    b=300;
    setfill('*');
    cout<<setw(5)<<a<<setw(5)<<b<<endl;
    cout<<setw(6)<<a<<setw(6)<<b<<endl;
}
```

```
**200**300
***200***300
```

(e) **Setfill:** It is used to control the number of digits of an output stream display of a floating point value. **Setprecision (int p)**

Example 6

 Write C++ program to use setprecision:

```
#include<iostream.h>
#include<iomanip.h>
void main( void)
{
    float a,b,c;
    a=5; b=3; c=a/b;
    setfill('*');
    cout<<setprecision(1)<<c<< endl;
    cout<<setprecision(5)<<c<< endl;
}
```

```
1.7
1.66667
```

WORK SHEET (2)

First Elements of C++

- Q1: What do you mean by C++ character set?
- Q2: What do you mean by identifiers? What is the maximum length of identifiers?
- Q3: What do you mean by case-sensitive?
- Q4: What do you mean by reserved word?
- Q5: Write a general layout of C++ program. Comment on each part of it.
- Q6: What is the main purpose of endl and \n ?
- Q7: List and comment on the special escape codes.
- Q8: What are the main types of variables, their sizes, and their range of values?
- Q9: What do you mean by constants?
- Q10: List the priorities of the arithmetic operations.
- Q11: Find the value of A for the following:
$$A = (5 + 2 * 3 + ((3 - 2) * 7) + -9) / 2.$$
- Q12: What are the main keywords included in iostream.h and math.h?
- Q13: What are the main differences between prefix and postfix notation?
- Q14: Find the value of B (true or false) for the following:
i = 5;
j = 9;

`B= ! ((i > 0) && (i >= j));`

Q15: Write C++ program to read x and compute sin, cos, and tan of x.

Q16: Rewrite the equivalent statements for the following examples, and find its results. Assume: $X=2$, $Y=3$, $Z=4$, $V=12$, $C=8$.

$(X+=5$, $Y-=8$, $Z*=5$, $V/=4$, $C\%=3$)

Q17: Given that A and B are real variables with values 1.5, and 2.5 respectively, and C is integer variable with value 3, evaluate the following: NOT ($A < 0$) AND ($B/C \leq 0$).

Q18: Write a program in C++ to find the area of a circle.

Q19: Write a program to read a set of (5) real no.s and find out the sum and average of them.