CHAPTER 8

OPERATORS AND EXPRESSIONS IN C++

OPERATORS

The operations (specific task) are represented by operators and the objects of the operation(s) are referred to as operands.

OPERATORS

- Of the rich set of operators c++ provides here we shall learn some. They are:––

1. Arithmetic operators
2. Increment/decrement operators
3. Relational operators
4. Logical operators
5. Conditional operators
6. Some other operators

1) ARITHMETIC OPERATORS

C++ provides operators for five (5) basic arithmetic operations :–

1. Addition (+)
2. Subtraction (–)
3. Multiplication (*)
4. Division (/)
5. Remainder (%)

ARITHMETIC OPERATORS

NOTE: Each of these is a binary operator i.e., it requires two values to (operands) to calculate a final answer.

But there are two unary arithmetic operators (that requires one operand or value) viz.

Unary +

Unary −

UNARY OPERATORS

Operators that act on one operand are referred to as unary operators.

UNARY +

The operator unary '+' precedes an operand. The operand (the value on which the operator operates) of the unary + operator must have arithmetic or pointer type and the result is the value of the argument.

For ex:–

If a=5 then +a means 5.

If a=0then +a means 0.

If a=–4 then +a means –4.

UNARY -

The operator unary '–' precedes an operand. The operand of an unary – operator must have arithmetic type and the result is the negation of its operand's value.

For ex:–If a=5 then –a means –5.

If a=0then –a means 0 (there is no quantity mnown as –0).

If a=–4 then a means 4.

This operator reverses the sign of the operand's value.

BINARY OPERATORS

Operators that act upon two operands are referred to as binary operators.

Note :The operands of a binary operator are distinguished as the left or right operand. Together, the operator and its operands constitute an expression.

ADDITION OPERATOR +

- The arithmetic binary operator + adds values of its operands and the result is the sum of the values of its two operands.
- For ex:–
- 4+20 results in 24.
- a+5(a=2) results in 7.
- a+b(a=4, b=6) results in 10.
- Its operands may be integer or float type.

SUBTRACTION OPERATOR -

- The – operator subtracts the second operand from first operand. For ex:–
- 14–3 results in 11.
- a–b(a=10, b=5) results in 5.
- The operands may be integer or float types.

MULTIPLICATION OPERATOR *

- The * operator multiplies the values of its operands. For ex :--
- 3*3results in 12.
- b*8 (b=2) results in 16.
- a*b (a=5, b=10) results in 50.
- The operand may be integer or float types.

DIVISION OPERATOR /

- The / operator divides its first operand by the second.
- For ex:--
- 100/5 evaluates to 20.
- a/2 (a=16) evaluates to 8.
- a/b (a=125, b= 25) results in 5.
- The operands may be integer, float or double types.

MODULUS OPERATOR %

- The % operator finds the modulus of the modulus of the first operand relative to the second. That is it produces remainder of dividing the first by the second operand.
- For ex:––
- 19%6 results in1.
- Operands must be integer types.

INCREMENT/DECREMENT OPERATORS(++, --)

The c++ name itself is influenced by the increment operator ++. The operator ++ adds 1 to its operand , and – subtracts one.

In other words,

a=a+1; is same as ++a; or a++;

and

a=a−1; is same as

−−a; or a−−;

INCREMENT/DECREMENT OPERATORS(++, --)

Both the increment and decrement operators come in two versions viz.

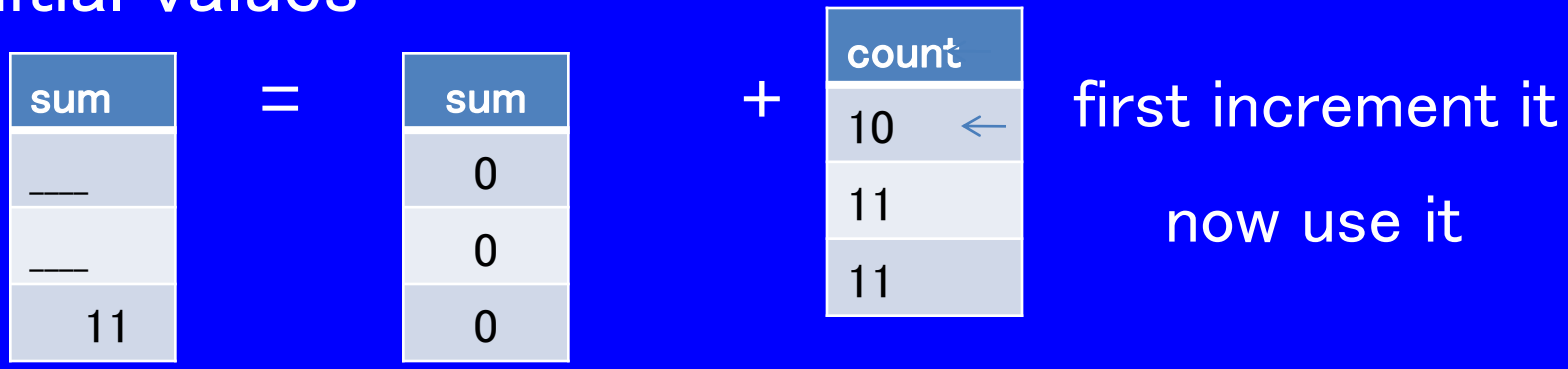
1. Prefix version
2. Postfix version

Though both of them have same effect on the operand, but they differ when they take place in an expression.

PREFIX VERSION

- When an increment or decrement operator precedes an operand we refer to it as prefix version (of the respective increment/decrement operator).
- When c++ encounters a prefix version it performs the increment/decrement operation before using the value of the operand.

EXAMPLE

- For ex:-
- Sum=sum+(++count);
- Will take place in the following fashion:
- (assume that initial values of sum and count are 0 and 10 respectively).
  Initial values
- 

-

NOTE

The prefix increment or decrement operators follow change–then–use rule. They first change (increment/decrement) the value of their operand. Then use the new values in evaluating the expression.

POSTFIX VERSION

- When an increment/decrement operator follows its operand we refer to it as postfix version (of the increment/decrement operator).
- When c++ faces a postfix operator it uses its value first and then performs increment/decrement operation upon the operand.

EXAMPLE

- Sum=sum + count++ ;
- Insert a table later on

POSTFIX INCREMENT / DECREMENT OPERATOR

The postfix increment/decrement operators follow use–then–change rule. They first use the value and then increments/decrements the operand's value.

MIND YOU!

The overall effect (as you must noticed by now) on the operand's value is the same in both the cases of prefix/postfix versions.

The increment/decrement operators are **unary operators**.

Postfix operators enjoy higher precedence over prefix operators.

PREFIX OPERATORS

- In turbo C++, firstly all prefix operators are evaluated prior to expression evaluation. The resultant value of prefix operator is planted in the expression and the expression is evaluated.
- Ex:–insert an example later on.

INCREMENT/DECREMENT OPERATORS

After being aware of the use of the increment/decrement operators (and of course the operators itself) you should not make multiple use of these two operators as it produces different results on different systems and is purely implementation dependent.

RELATIONAL OPERATORS

The operators which determine the relations among different operands. C++ provides six different relational operators which works with numbers and characters but not with strings.

These relational operators are:––

1. < (less tan)
2. <= (less than or equal to)
3. == (equal to)
4. > (greater than)
5. >= (greater than or equal to)
6. != (not equal to)

KILL YOUR DOUBTS

You should never ever confuse between = and == operators. This is the most common mistake while working with relational operators.

You should avoid getting stuck with silly results. Just you need to know that = is an assignment operator (which assigns a value to the variable it follows) while == is a relational operator (which compares two values characters or numbers).

TIP

Avoid equality comparisons on floating-point numbers.

Floating-point arithmetic is not so exact and accurate as the integer arithmetic is. After any calculation involving floating-point numbers there may be a small residue error. Beause of this error you should avoid equality and inequality operations between floating-point numbers.

TIP

Avoid comparing signed and unsigned values.

It is because if you compare signed and unsigned values the compiler treats a signed value as unsigned. So problem arises when comparison involves any negative value. The results can be as different as you can think for yourself.

EXAMPLE

In C++ these relational operators can be used as,

1)
```
if(a>b)
   {
      cout<<"A is Big";
   }
```

2)
```
while(i<=20)
      {
            cout<<i;
            i++;
      }
```

GROUPING

The relational operators group left to right. That means a<b<c means (a<b)<c and not a<(b<c).

LOGICAL OPERATORS

In the previous topic we learnt about relational operators. Now, we shall learn about logical operators.

- Logical operators refer to the ways these relationships (among values) can be connected.
- C++ provides three logical operators . They are:–

1. || (logicalOR)
2. && (logical AND)
3. ! (logical NOT)

THE LOGICAL OR OPERATOR ||

The logical OR operator (||) combines two expressions which make its operands. The logical OR (||) operator evaluates to true, giving value 1, if any of its operands evaluates to true.

NOTE:– C++ considers 0 as a false value and any non–zero value as a true value. Values 0 and 1(false or true) are the truth values of expressions.

EXAMPLE

The principle is used while testing evaluating expressions. For example:–

```
if(ch=='a' || ch=='e'|| ch=='i' || ch=='o'|| ch=='u')
        {
                cout<<"Entered Character is Oval";
        }
else
        {
                cout<<"Entered Character is consonant";
        }
```

The operator || (logical OR) has lower precedence than the relational operators, thus, we don't need to use parenthesis in these expressions.

LOGICAL AND OPERATOR (&&)

It also combines two expressions into one.

The resulting expression has value 1 or 0 indicating true and false respectively.

The resulting expression takes value 1 if both of the original expressions (operands) are true.

Insert some examples.

LOGICAL AND OPERATOR (&&)

The logical operator AND (&&) has lower precedence over the relational operators.

THE LOGICAL NOT OPERATOR (!)

The logical NOT operator, written as !, works on single expression or operand i.e., it's n unary operator.

The logical NOT operator negates or reverses the truth value of the expression following it i.e., if the expression is true , then the !expression is false and vice–versa.

Insert some examples later on.

THE LOGICAL NOT OPERATOR (!)

- The logical negation operator(!) has a higher precedence over all other arithmetical and relational operators. Therefore, to negate an expression, you must enclose the expression in parentheses.

TIP

- The unary negation operator is useful as a test for zero.
- Thus, the condition if(check==0) can be replaced by if(!check).

SOME FACTS ABOUT LOGICAL OPERATORS

- The precedence order among logical operators is NOT, AND and OR (!, &&, ||).

CONDITIONAL OPERATOR ?:

- C++ offers a conditional operator (?:) that stores a value depending upon a condition.
- The operator is ternary operator meaning it requires three operands.
- The general form :–
- Expression1 ? Expression2: Expression3
- If expression1 evaluates to true i.e.1, then the value of whole expression is the value of expression2, otherwise, the value of the whole expression is the value o0f the exspression3.
- Insert an example later on.

BEWARE!!!

- You will enjoy working with the conditional operator except that you must know that:–

The conditional operator has a low precedence.

- The conditional operator has a lower precedence than most other operators that may produce unexpected results at times.
- Insert an example later on.

CONDITIONAL OPERATOR ?:

- The conditional operator can be nested also i.e., any of the expression2 or expression3 can be other conditional operator.
- Give an example later on.

CONDITIONAL OPERATOR ?:

- The conditional operator is allowed on left side of the expression.

CONDITIONAL OPERATOR ?:

In C++, the result of the conditional operator ?: is an **lvalue**, provided that the two alternatives (true part alternative, false part alternative) are themselves values of the same type.

As you already know, an lvalue is an expression to which you can assign a value. There must be an lvalue on the left side of an assignment operator. This means that you can assign a value to a conditional expression.

SOME OTHER OPERATORS

In this section, we discuss two of many other operators (in C++) which are of greater relevance to us at the moment. They are :

1. The compile-time operator sizeof
2. The comma operator

sizeof OPERATOR

It is a unary compile-time operator that returns the length (in bytes) of the variable or parenthesized type-Specifier that it precedes.that is, it can be used in two forms :

1. sizeof var (where var is declared variable)
2. sizeof(type) (where type is a C++ data type)

THE COMMA OPERATOR

A comma operator is used to string together several expressions.

The group of expressions separated by commas(,) is evaluated left-to-right in sequence and the result of the right-most expression becomes the value of the total comma-separated expression.

- For ex:-
- b=(a=3,a=1);

NOTE

The parentheses are necessary because the comma operator has a lower precedence than the assignment operator.

The comma operator has lowest precedence to all these operators.

PRECEDENCE OF OPERATORS

Precedence of operators
++(post increment),--(post decrement)
++(pre decrement), --(pre increment)
*(multiply),/(divide),%(modulus)
+(add),-(subtract)
<(less than),<=(less than or equal),>(greater than),>=(greater than or equal)
==(equal), !=(not equal)
&&(logical AND)
||(logical OR)
?:(conditional expression)
+(simple assignment) and other assignment operators (arithmetic assignment operator)
Comma operator

EXPRESSIONS

An expression in C++ is any valid combination of operators, constants and variables.

EXPRESSION

The expression in C++ can be of any type i.e., relational, logical etc.

Type of operators used in an expression determines the type of expression.

ARITHMETIC EXPRESSIONS

Arithmetic expression can either be *integer* or *real expressions.*

Sometimes a mixed expression can also be formed which is a mixture of real and integer expressions.

INTEGER EXPRESSIONS

Integer expression is formed by connecting integer constants and/or integer variables using integer arithmetic operators.

Following expressions are valid integer expressions:--

const count =30;

int i, j, k, x, y, z;

a) i
b) -i
c) k-x
d) k+x-y+count
e) -j+k*y
f) j/z
g) z%x

REAL EXPRESSIONS

Real expressions are formed by connecting real constants and/or real variables using real arithmetic operators (e.g., % is not a real arithmetic operator).

The following are valid real expressions :--

```
const bal=250.53;
float qty,amount,value;
double fin,inter;
```

i. qty/amount
ii. qty*value
iii. (amount +qty*value)-bal
iv. fin+qty*inter
v. inter-(qty*value)+fin

RULE

An arithmetic expression may contain just one signed or unsigned variable or a constant, or it may have two or more variables and/or constants, or two or more valid arithmetic expressions joined by a valid arithmetic operators. Two or more variables or operators should not occur in continuation.

REAL EXPRESSIONS CONTD..

Apart from variables and constants and arithmetic operators, an arithmetic expression may consist of C++'s mathematical functions that are part of c++ standard library and are contained in header files ***math.h*** . To use the mathematical functions, you must include math.h.

MATH.H FUNCTIONS

The general form:--

Functiontype functionname (argument list);

Functiontype-specifies type of value returned by the functionname

argument list-specifies arguments and their data type (separated by commas as in int a, real b, float d,) as required by the functionname.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	Description	example
1	acos	double acos (double arg)	the acos () function returns the arc cosine of arg. The argument to acos () must be in the range of −1 t o +1; otherwise a domain error occurs.	Diuble val=−0.5; cout<<acos (val);

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
2	asin	double asin(double arg)	The **asin()** function returns the arc sine of *arg*. The argument to asin must be in the range −1 to 1.	double val=-10;cout<<asin (val);

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
3	atan	double asin(double arg)	The **atan()** function returns the arc tangent of arg.	atan (val);(val is a double type identifier)

MATHEMATICAL FUNCTIONS IN math.h

s. no.	Function	prototype	description	example
4	atan2	double atan2(double b, double a)	The **atan2()** function returns the arc tangent of b/a.	couble val=-1.0;cout<<atan2(val,1.0);

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
5	ceil	double ceil(double num)	The **ceil()** function returns the smallest integer represented as a double not less than *num*.	*ceil*(1.03) gives 2.0 ceil(−1.03) gives −1.0 .

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	Example
6	cos	double cos (double arg)	The **cos()** function returns the cosine of arg. The value of arg must be in radians.	cos(val) (val is a double type identifier)

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
7	cosh	double cosh(double arg)	The **cosh()** function returns the hyperbolic cosine of *arg*. The value of *arg* must be in radians.	Cosh(val) (val is a double type identifier.)

MATHEMATICAL FUNCTIONS IN math.h

s. no.	Function	prototype	Description	example
8	exp	double exp(double arg)	The **exp()** function returns the natural logarithm e raised to power *arg*.	*Exp(2.0)* gives the value of e^2.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	Example.
9	fabs	double fabs(double num)	The **fabs()** function returns the absolute value of num.	fabs(1.0) gives 1.0 fabs(−1.0) gives 1.0.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
10	floor	Double floor(double num)	The **floor()** functions returns the largest integer (represented by double) not greater than *num.*	Floor(1.03)gives 1.0 floor (−1.03) gives −2.0.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
11	fmod	double fmod(double x, double y)	The **fmod()** function returns the remainder of the division x/y.	fmod(10.0, 4.0) gives 2.0.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
12	log	double log(double num)	The **log()** function returns natural logarithm for *num*. a domain error occur if num is negative and a range error occur if the arg num is 0.	log(1.0) gives the natural logarithm for 1.0.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
13	log10	double log10(double num)	The **log10()** function returns the base10 logarithm for num. A domain error occurs if num is negative and range error occurs if the argument is 0.	log 10(1.0) gives base 10 logarithm for 1.0.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
14	pow	double pow(double base, double exp)	The **pow()** function returns the base raised to the power exp. A domain error occurs if the base is 0 and exp<=0. also if base<0 and exp is not an integer.	pow(3.0, 1) gives 3.0.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
15	sin	double sin(double arg)	The **sin()** function returns the sin of arg. The value of *arg* must be in radians.	Sin(val) (val is a double type identifier).

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
16	sinh	double sin (double arg)	The **sinh()** function returns the hyperbolic sine of arg. The value of arg must be in radians.	Sinh(val) (val is a double type identifier).

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
17	sqrt	double sqrt(double num)	The **sqrt()** function returns the square root of the num. A domain error occur if num<0.	Sqrt(4.0) gives 2.0.

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
18	tan	double tan(double arg)	The **tan** () function returns the tangent of *arg*. The value of arg must be in radians.	tan(val)

MATHEMATICAL FUNCTIONS IN math.h

s. no.	function	prototype	description	example
19	tanh	double tanh(double arg)	The **tanh()** function retuns the hyperbolic tangent of arg . The arg must be in radians.	tanh(val)

TYPE CONVERSION

Def…

The process of converting one predefined data type to another is called Type Conversion.

TYPE CONVERSION

C++ facilitates the type conversion in *two* forms:---

1) Implicit type conversion
2) Explicit type conversion

IMPLICIT TYPE CONVERSION

It’s a conversion performed by the compiler without any intervention of the user.

Applied generally whenever differing data types are intermixed in an expression (mixed mode expression), so as not to lose information.

IMPLICIT TYPE CONVERSION

The C++ compiler converts all operands upto the type of the largest operand, which is called ***Type promotion.***

IMPLICIT TYPE CONVERSION

Step no.	If either's type is	The resultant type of other operand	otherwise
1	long double	long double	Step2
2	double	double	Step3
3	float	float	Step4
4	–	Integral promotion takes place followed by step5	–
5	unsigned long	unsigned long	Step6
6	long int and the other is unsigned int	(1) long int (provided long int can represent all values of Int) (2) Unsigned long int (if all values of unsigned int can't be represented by long int)	Step7
7	long	long	Step7
8	unsigned	Unsigned	Step8

EXPLICIT TYPE CONVERSION

DEF…

The Explicit Conversion Of An Operand To A Specific Type Is Called TYPE CASTING.

EXPLICIT TYPE CONVERSION

- Type casting in C++ :-

  (type) expression;

Here type is a valid C++ data type to which conversion is to be done.

casts are often considered as operators. As an operator, a cast is *unary* and has same precedence as any unary operator.

EXPRESSION EVALUATION

In C++, mixed expression is evaluated as follows:-

1. It is first divided into component sub-expressions up to the level of two operand s and an operator.
2. Then the type of the sub-expression is decided using earlier stated general conversion rules.
3. Using the results of sub-expressions, the next higher level of expression is evaluated and its type is determined.
4. This process goes on until you have the final result of the expression.

LOGICAL EXPRESSION

DEF…

The expressions that results into true(1) or false(0) are called logical expressions.

ASSIGNMENT STATEMENT

Assignment statement assigns a value to a variable. In C++,

Equal to (=) symbol is an assignment statement.

For example:

A=8495;

B=564.44;

C++ SHORT HANDS

Different Types of Assignment statements are used while programming and they are,

+ = example x+=10 mean x=x+10

- = example y-=10 mean y=y-10

* = example z*=10 mean z=z*10

/ = example a/=10 mean a=a/10

% = example b%=10 mean b=b%10