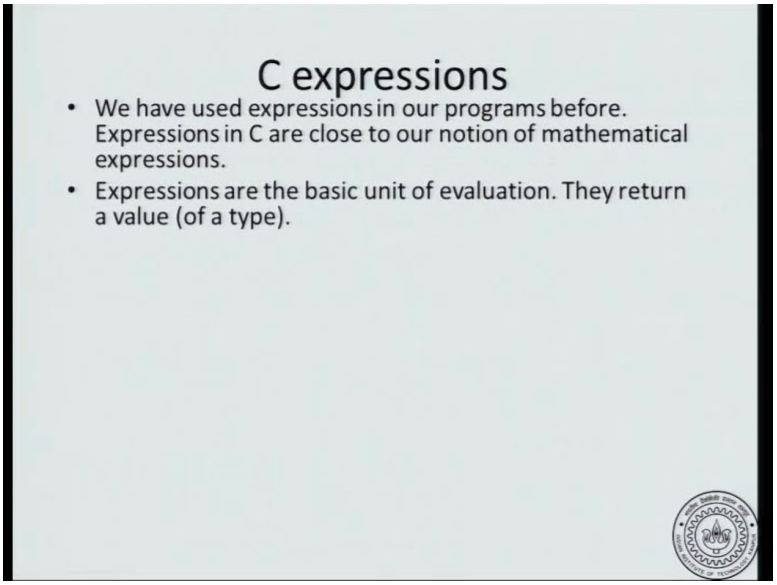
Introduction to Programming in C
Department of Computer Science and Engineering

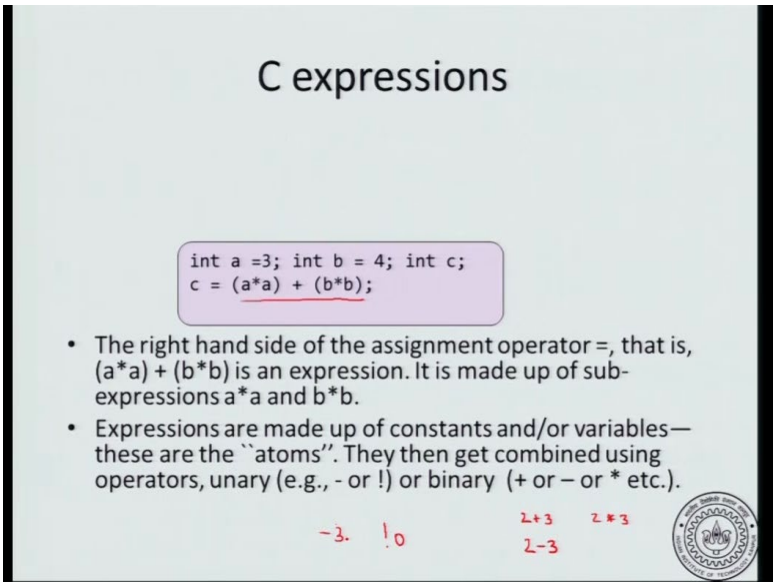
In the session, we will discuss operators and expressions. So, we have already used C expressions in our programs before.

(Refer Slide Time: 00:09)



And expressions in c are similar to expressions in mathematics and they follows tools, similar to what mathematical expressions also follow. They are a basic unit of evaluation and each expression has a value. Say, that an expression returns a value of a particular type.

(Refer Slide Time: 00:38)

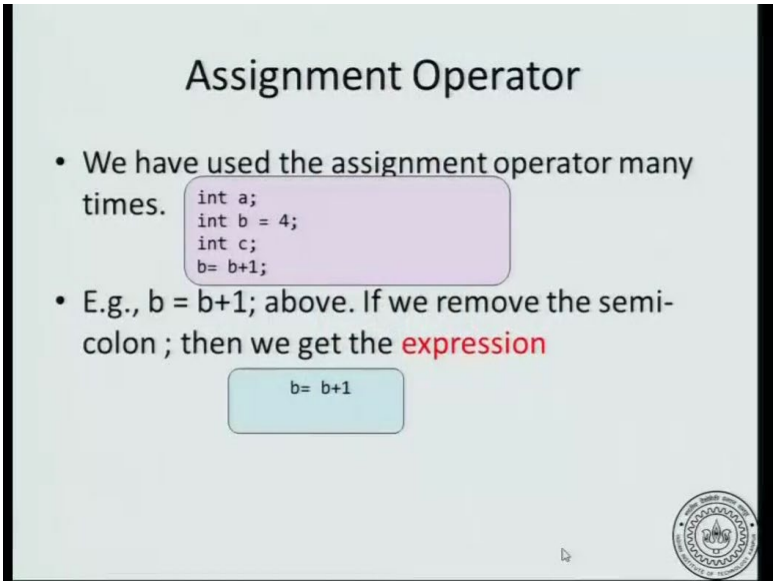


So, let us consider a few example expressions. For example, I have the following, a is 3, b is 4 and I have a variable c, which is just declared to be of type A. And then, say that c = (a * a) + (b * b). So, the right hand side of the assignment operator, this is a assignment operator. And the right hand side is an expression and that expression has sub expressions, a * a and b * b within parenthesis.

So, an expression can be made up of variables, it can be made up of constants. These are the atoms or the basic components of an expression. And sub expressions can be combined into bigger expressions, using operators. Now, operators can be unary that is, they take one argument operation. For example, on unary operators the examples can be - , which is the unary -. For example, -3 is a negative number. Similarly, NOT operator that we have seen in connection with logical operations so, NOT of zero, for example, the logical negation operator. Both of these operations take one argument. Now, there is also the binary operations like +, -, *, etcetera. So, + takes two arguments. For example, an expression like 2 + 3 and here is the binary -. So, if I say 2 -3, this is actually a binary operator which takes two arguments, which are 2 and 3.

Similarly, the binary multiplication 2 * 3 would be the product of 2 and 3. So, notice the difference between… It is the same sign for the unary - and the binary -. But, the unary - takes only one argument and the binary - takes two arguments. We have used the assignment operation many times and let us understand that in, somewhat more detail.

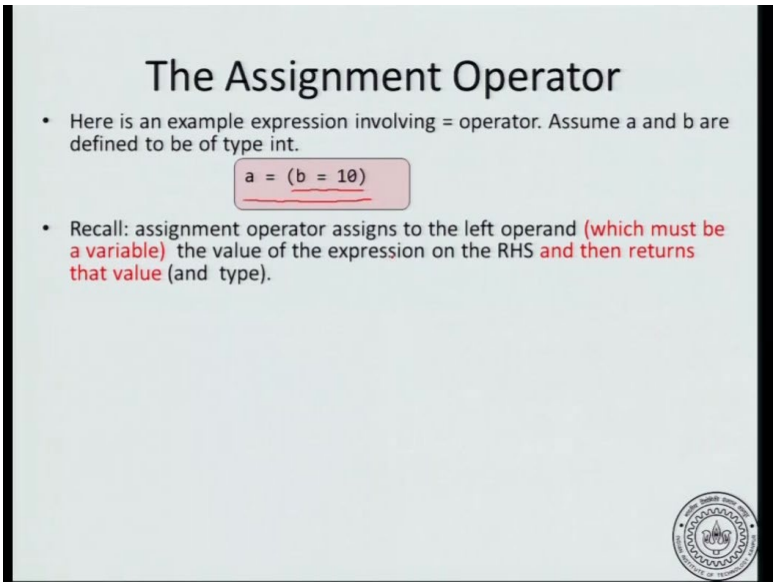
(Refer Slide Time: 03:12)



For example, if you consider the expression b = b + 1. Now, if you remove the semicolon

at the end. So, the statement is b = b + 1 semicolon. And if you omit the semicolon, what you get is an assignment expression, b = b + 1 without the semicolon.

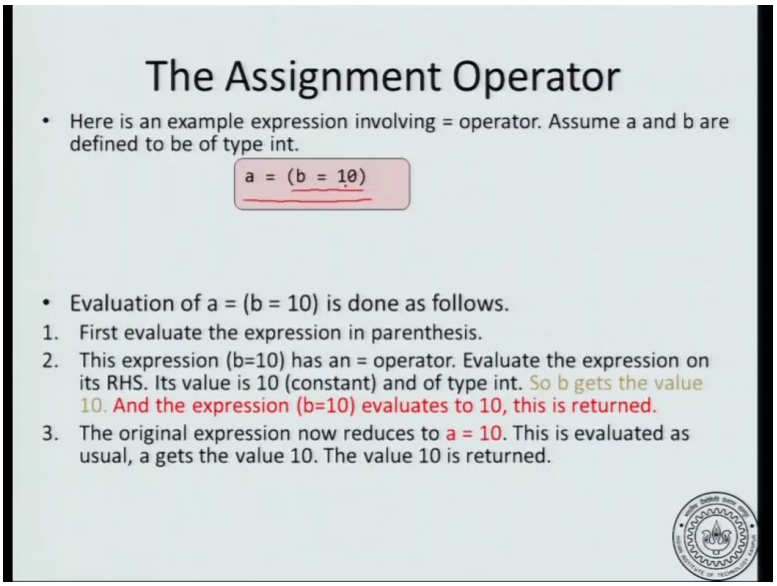
(Refer Slide Time: 02:28)



So, how does the assignment operation work? For example, consider an expression like a = (b = 10). What does this do? So, assume that a and b are integer variables. Now, assignment assigns to the left hand variable, left hand operand, the value of the expression on the right hand side. For example, in this assignment operation there are two assignment expressions.

One is the expression b = 10. And the second is the expression a = b = 10. So, the first assignment expression is supposed to do the following, assign 10 to b. So, what it does is, it assigns the value of the right expression which is 10 in this case to the left hand side operand that is one thing, it does. And also, it returns the value after the assignments. So, 10 has been assigned to b. And the return value of this expression is 10.

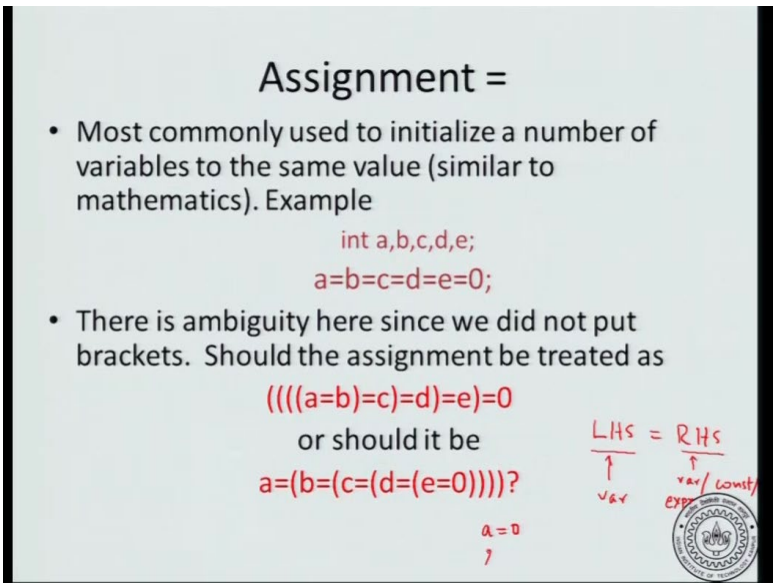
(Refer Slide Time: 04:47)



So, we can now analyze a = b = 10, as follows. First, evaluate the expression in parenthesis. The expression b = 10 has an assignment operator. So, evaluate the expression on the right hand side and then assign it to b. Now, that operation returns. So, that expression returns a particular value, which is 10. Now, the original expression can be thought of as, just a = 10. This is evaluated as usual.

So, you take 10 and assign it to a. And the return value of the whole expression becomes 10. So, when executing this expression, when evaluating this expression, two variables are assigns their values. One is b, which is assigned the value 10 and the second is a, which is also assigned the value 10.

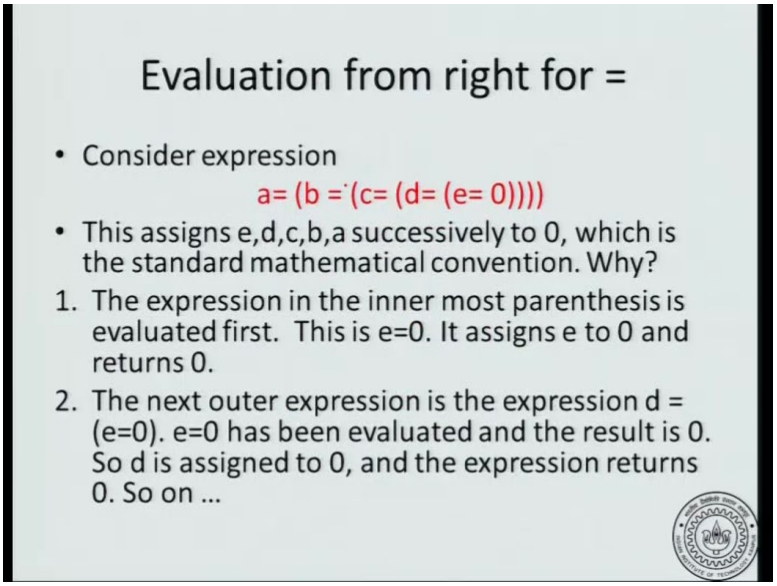
(Refer Slide Time: 05:49)



The assignment operation can be used to initialize a number of variables, in one shot. For example, if I write a statement like a = (b= (c = (d= (e=0)))). What does this mean? Now, here there is some ambiguity here, because we do not know which order to evaluate this. Should, we evaluate from left to right. Should, we evaluate from right to left. Does it matter?

So, should the assignment be treated as the following, where a = b is done first, then, = c, then, = d and. So, on. Or should it be the opposite way right to left, where e = 0 is first done. Then, d = that, then c = that,. So, on until a.

(Refer Slide Time: 06:39)



So, the expression is evaluated from right to left, in the case of the assignment operation. For example, the above expression that we just saw will be done as, a =… So, e = 0,

first and then backward, until a is assigned. Now, this is also the standard mathematical convention. We are not introducing a new strange rule, here. Why is this? First, we will evaluate the inner most expression, which is e = 0.

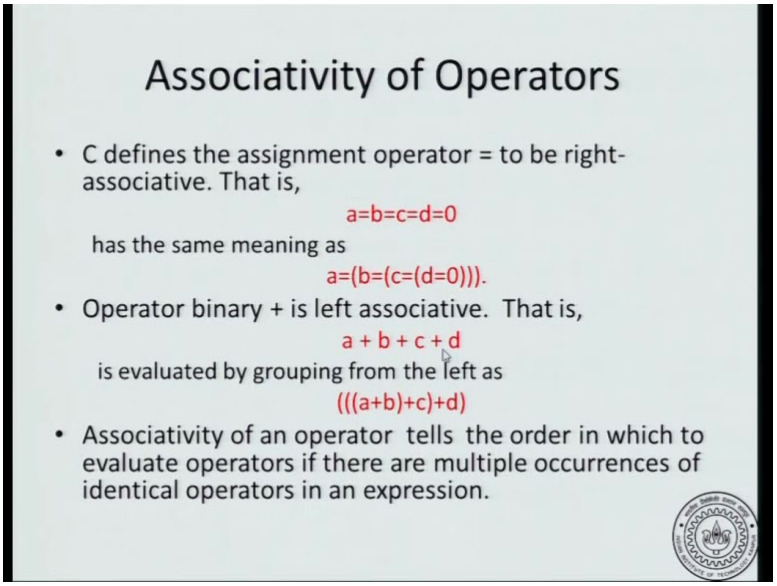
So, e will be assigned 0, then the return value of this sub expression. So, this sub expression will return the value 0. So, this becomes d = 0, d is assigned the value 0. And the return value of this sub expression becomes 0. So, then we have c = 0 and. So, on. So, finally, every variable here will be assigned the value 0. So, the reason for doing this is that, if you try to do it in the opposite way, you will see that uninitialized variables are initialized to other uninitialized variable.

For example, if you go from left to right, in the previous. This simply does not make any

sense, because you have just declared a b c and. So, on. And when you say a = b, a and b are not initialized yet. So, this assignment hardly makes any sense. The basic rule of assignment is that, left hand side = right hand side. So, the left hand side is some value that can be assigned to.

For example, this is a variable. The right hand side can be anything, variable, constant or it can be an expression. So, all these are valid assignment. So, what is an invalid assignment? So, a = 0 can be a valid assignment but, 0 = a. So, the assignment operation is evaluated, right to left.

(Refer Slide Time: 09:11)

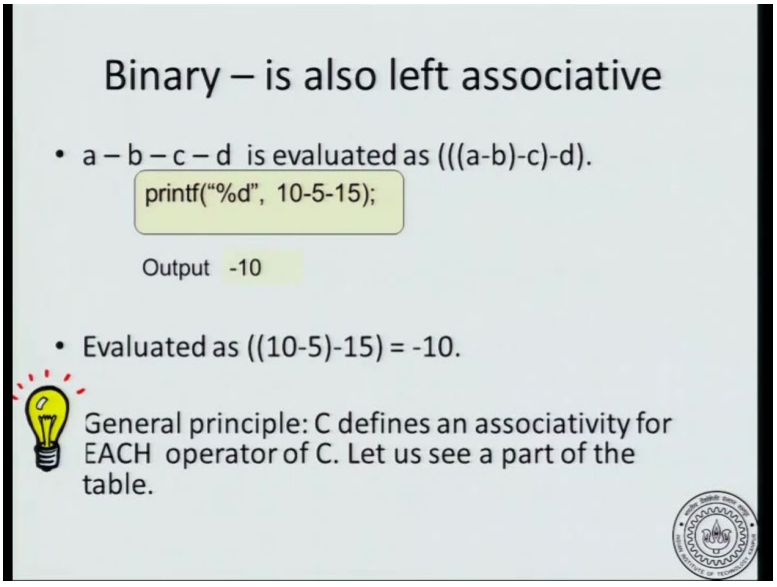


Now, we have the concept of associativity of operators. So, what does associativity mean? It is, we have just argued that, a = b = c = d = 0. An expression like that will be evaluated from right to left. So, it is as though, we have parenthesized the expression as d = 0, inner most. Then, c = that, then b = that and. So, on. So, on the other hand, if you take an operator like binary + the addition symbol, then the usual custom is that you parenthesis from left to right.

So, the evaluation is done, a + b first. Then, that sum is added to c. Then, that is added to d. So, the assignment operation goes right to left. The addition symbol operates left to right. So, this concept of associativity of an operator tells us, the order in which we evaluate the operations, if there are multiple occurrences of the same operator. So, the first there are multiple occurrences of the = sign. In the second, there are multiple occurrences of the addition symbol..

So, associativity rules tells you that, if there are identical operators in an expression, in which order do you evaluate them? Do you evaluate them from left to right? If you do, then it is called a left associative operator. If you evaluate from right to left, in the case of, for example, the assignment, then it is called a right associative operator.

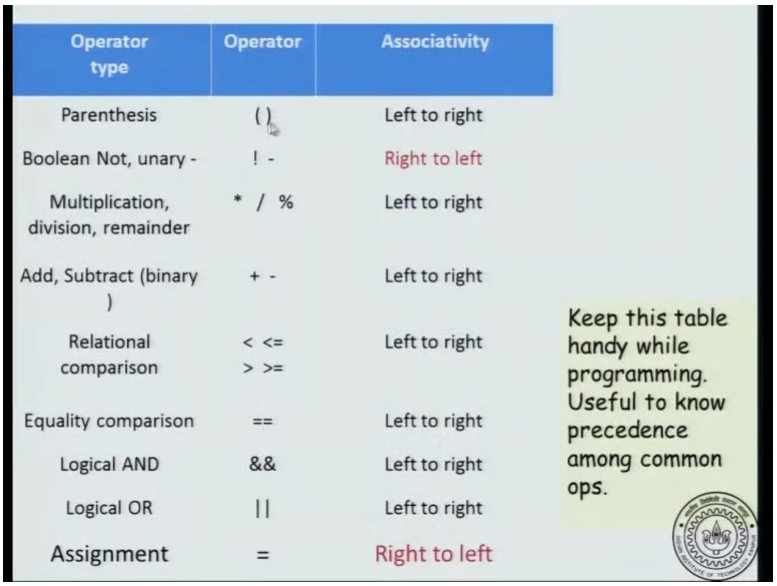
(Refer Slide Time: 11:00)



Binary - is also left associative. For example, a - b - c - d is evaluated as a - b, then c then - c, then - d. So, for example, if you say 10 - 5 - 15, what will be done is 10 - 5 and then - 15. So, this is 5 - 15, which is - 10. Whereas, if the parenthesis had been in the opposite way, it would be 10 - 5 - 15, which case it could be 10 -, this is - 10 which is 20.

Notice that, this is not how you are supposed to do it, even in mathematics. So, the way that c does handles the associativity of the binary operation, is correct. So, the correct parenthesis is 10 - 5 and then - 15. In general, for every operator c defines an associativity. So, let us see the part of the associativity of operations in c.

(Refer Slide Time: 12:23)



There are several operations that we have seen,. So, far. The parenthesis, the Boolean naught, the logical naught and the unary -, the binary multiplication, division and. So, on. Addition symbol, comparison less than, less than or = and. So, on. Equality, logical AND, logical OR and then the assignment operator. We have seen, all these operations,. So, far. And of this, the typical associativity is left to right.

There are couple of exceptions, one we have already seen. Assignment operation is right to left. The unary operations are also right to left. Most of the other operations are left to right. So, if you think for a little bit, you can see that the associativity for unary operations is also easily seen to be right to left. That makes more sense.

So, the idea is not that you should memorize this table but, you should understand. Given the table, can I understand, what will happen with an expression? How c will evaluate it? It is not that, you should remember this. But, rather if you are given the table and an expression, can you correctly calculate what the value of the expression will be.