

## Priorities of Operations

In programming, operators have *Priority levels* that determine which operations are performed first. In mathematics we expect the result of  $2 \times 2 + 3 \times 3$  to be 13 because  $\times$  is supposed to be done before  $+$ , rather than the 21 we would get by working from left to right. The same rule applies in programming. The three operators  $*$ ,  $/$ , and  $\%$  have high priority and are performed before the two low priority operators  $+$  and  $-$ . Just as in mathematics, you can use parentheses (round brackets) to impose a different ordering if that is what you want. When there is a sequence of operators with the same priority (as in  $20 * 3 / 7$ ) they are taken from left to right. Just to confirm what you have probably already observed: there is nothing new here; operators in C++ are intended to work in the way you would naturally expect. There is a small fly in the ointment, adding some confusion: the monadic versions of  $+$  and  $-$  have higher priorities than any other arithmetic operators. The following examples should demonstrate the rules:

Expression	Value	Comments
$2 * 3 + 4 * 5$	26	$*$ before $+$ , so its the same as $6 + 20$
$2 * (3 + 4) * 5$	70	Parentheses always win, so its the same as $2 * 7 * 5$
$2 * (3 + 4 * 5)$	46	The same as $2 * 23$
$9 - 4 - 2$	3	Left to right rule
$3 * 3 - 2 * 2 - 2$	3	The same as $9 - 4 - 2$
$(3 * 3) - (2 * 2) - (1 + 1)$	3	The same as $9 - 4 - 2$
$8 + 1 - 3 + 1 - 1 + 1$	7	Left to right rule
$(8 + 1) - (3 + 1) - (1 + 1)$	3	The same as $9 - 4 - 2$
$((1 + (2 * 3)))$	7	Unnecessary parentheses are not wrong
$144 / 6 / 3$	8	Left to right rule
$144 / (6 / 3)$	72	Same as $144 / 2$
$10 - 2 * 3$	4	$*$ before $-$
$-2 * 3$	-6	As expected, but: monadic $-$ before $*$

The nice thing about it is that if ever you're not quite sure exactly how an operator will behave in an expression, there are two foolproof solutions. One is to put in so many parentheses that it can't be wrong. For instance, you want to divide 144 by 6 and then divide the result by 3, you think that the expression  $144 / 6 / 3$  will do, but have a nagging worry that maybe the  $6 / 3$  will be done first. Solution: type  $(144 / 6) / 3$  instead, and you can't go wrong. It turns out that the parentheses weren't needed, but so what?