Precedence and Associativity Of Operators :

→ For evaluation of expressions having more than one operator, there are certain precedence and associativity rules defined in C

→ In C language, operators are grouped together and each group is given a precedence level. The precedence of all the operators is given in the following table. The operators with precedence level 1 have highest precedence and with precedence level 15 have lowest precedence.

Operator	Description	Precedence level	Associativity
( )	Function call		
[ ]	Array subscript	1	Left to Right
→	Arrow operator		
•	Dot operator		
+	Unary plus		
–	Unary Minus		
++	Increment		
– –	Decrement		
!	Logical NOT	2	Right to Left
~	One's Complement		
&	Address		
sizeof	Size in bytes		
(datatype)	Typecast		
*	Multiplication		
/	Division	3	Left to Right
%	Modulus		

operator	Description	Precedence level	Associativity
+ −	Addition Subtraction	4	Left to Right
<< >>	Left shift Right shift	5	Left to Right
< <= > >=	Less than Less than or equal to Greater than Greater than or equal to	6	Left to Right
== !=	Equal to Not equal to	7	Left to Right
&	Bitwise AND	8	Left to Right
^	Bitwise XOR	9	Left to Right
|	Bitwise OR	10	Left to Right
&&	Logical AND	11	Left to Right
||	Logical OR	12	Left to Right
?:	Conditional Operator	13	Right to Left
= *= /= %= += −= &= ^= |= <<= >>=	Assignment Operator	14	Right to Left
,	Comma Operator	15	Left to Right

Evaluation Of Expressions :

Rules for evaluation of Expression :

- First, parenthesized sub expression from left to right are evaluated.

- If parentheses are nested, the evaluation begins with the innermost sub-expression.

- The precedence rule is applied in determining the order of application of operators in evaluating sub-expressions.

- The associativity rule is applied when two or more operators of the same precedence level appear in a sub-expression.

- Arithmetic expressions are evaluated from left to right using the rules of precedence.

- when parentheses are used, the expressions within parentheses assume highest priority.

Problems :

1) Evaluate the expression $x = a - b/3 + c * 2 - 1$ where $a = 9$, $b = 12$ and $c = 3$.

Soln. $x = a - b/3 + c * 2 - 1$, where $a = 9$, $b = 12$ & $c = 3$

so, the expression becomes

$$x = 9 - \underbrace{12/3}_{1} + \underbrace{3 * 2}_{2} - 1$$ [* & / have same precedence, so it evaluated from left to right]

$$\Rightarrow x = 9 - 4 + \underbrace{3 * 2}_{2} - 1$$

$\Rightarrow x = \underbrace{9-4}_{3} + 6 - 1$ [+ & – have the same precedence so it is evaluated from left to right]

$\Rightarrow x = \underbrace{5 + 6}_{4} - 1$

$\Rightarrow x = \underbrace{11 - 1}_{5}$

$\Rightarrow \boxed{x = 10}$

2) Evaluate the expression $9 - 12/(3+3) * (2-1)$

Sol⁹ Expression is $9 - 12/(3+3) * (2-1)$

let $x = 9 - 12/\underbrace{(3+3)}_{1} * (2-1)$ [parentheses have the highest precedence level & it is evaluated from left to right]

$\Rightarrow x = 9 - 12/6 * \underbrace{(2-1)}_{2}$

$\Rightarrow x = 9 - \underbrace{12/6}_{3} * 1$ [* & / have same precedence level & these are evaluated from left to right]

$\Rightarrow x = 9 - \underbrace{2 * 1}_{4}$

$\Rightarrow x = \underbrace{9 - 2}_{5}$

$\Rightarrow \boxed{x = 7}$

3) Evaluate the expression $x = 9 - (12/(3+3) * 2) - 1$

Sol⁹ $x = 9 - (12/(3+3) * 2) - 1$

$\Rightarrow x = 9 - (12/6 * 2) - 1$

$\Rightarrow x = 9 - (2 * 2) - 1$

$\Rightarrow$ $x = 9 - 4 - 1$

$\Rightarrow$ $x = 5 - 1$

$\Rightarrow$ $\boxed{x = 4}$

4) Evaluate the expression $x = 9 - ((12/3) + 3 * 2) - 1$

Sol^n $x = 9 - ((12/3) + 3 * 2) - 1$

$\Rightarrow$ $x = 9 - (4 + 3 * 2) - 1$

$\Rightarrow$ $x = 9 - (4 + 6) - 1$

$\Rightarrow$ $x = 9 - 10 - 1$

$\Rightarrow$ $x = -1 - 1$

$\Rightarrow$ $\boxed{x = -2}$

*) $5 + 16 / 2 * 4$

Sol^n $5 + 16 / 2 * 4$

$= 5 + 8 * 4$

$= 5 + 32$

$= \boxed{37}$

*) $20 - 7 - 5 - 2 - 1$

Sol^n $20 - 7 - 5 - 2 - 1$

$= 13 - 5 - 2 - 1$

$= 8 - 2 - 1$

$= 6 - 1$

$= \boxed{5}$

*) $(22 - 4) / (2 + 4 * 2 - 1)$

Sol^n $(22 - 4) / (2 + 4 * 2 - 1)$

$= 18 / (2 + 4 * 2 - 1)$

$= 18 / (2+8-1)$

$= 18 / (10-1)$

$= 18/9$

$= \boxed{2}$

*) $(4 * (3+2)) / 10$

Soln: $(4 * (3+2))/10$

$= (4 * 5)/10$

$= 20/10$

$= \boxed{2}$

*) Evaluate the expression $a+b-(c+d)*3 \% e + f/9$, where $a=8$, $b=4$, $c=2$, $d=1$, $e=5$ and $f=20$.

Soln: Expression: $a+b-(c+d)*3\%e+f/9$, where $a=8$, $b=4$, $c=2$, $d=1$, $e=5$ & $f=20$.

So the expression becomes

$$8+4-(2+1)*3\%5+ {}^{20}/_{9}$$

$$= 8+4-3*3\%5+{}^{20}/_{9}$$

$$= 8+4-9\%5+{}^{20}/_{9}$$

$$= 8+4-9\%5+{}^{20}/_{9}$$

$$= 8+4-4+{}^{20}/_{9}$$

$$= 8+4-4+2$$

$$= 12-4+2$$

$$= 8+2$$

$$= \boxed{10 \,(\text{Ans})}$$

Assignment : Evaluate the expression $a\%6 - b/2 + (c \times d - 5)/e$ where $a = 17$, $b = 5$, $c = 6$, $d = 3$, $e = 5$

Soln $a\%6 - b/2 + (c*d-5)/e$, where $a = 17$, $b = 5$, $c = 6$
$$d = 3, e = 5$$

$\therefore$ $17\%6 - 5/2 + (6*3-5)/e$

$= 17\%6 - 5/2 + (18-5)/e$

$= 17\%6 - 5/2 + 13/5$

$= 5 - 5/2 + 13/5$

$= 5 - 2 + 13/5$

$= 5 - 2 + 2$

$= 3 + 2$

$= \boxed{5}$

Assignment : Evaluate the expression $a*b - c/d < e + f$, where $a = 4$, $b = 5$, $c = 6$, $d = 3$, $e = 5$ and $f = 10$

Soln $a*b - c/d < e + f$, where $a = 4$, $b = 5$, $c = 6$, $d = 3$
$$e = 5, f = 10$$

So $4*5 - 6/3 < 5 + 10$

$= 20 - 6/3 < 5 + 10$

$= 20 - 2 < 5 + 10$

$= 18 < 5 + 10$

$= 18 < 15$

$= \boxed{0}$

Assignment : $a - b + c/d == e/f - g + h\%k$, where $a = 8$, $b = 5$, $c = 8$, $d = 3$, $e = 65$, $f = 10$, $g = 2$, $h = 5$, $k = 2$.

Sol^n $a - b + c/d == e|f - g + h \% K$, where $a = 8, b = 5, c = 8,$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad d = 3, e = 65, f = 10, g = 2$

So $8 - 5 + 8/3 == 65/10 - 2 + 5\%2$ $h = 5, K = 2.$

$\Rightarrow 8 - 5 + 2 == 65/10 - 2 + 5\%2$

$\Rightarrow 8 - 5 + 2 == 6 - 2 + 5\%2$

$\Rightarrow 8 - 5 + 2 == 6 - 2 + 1$

$\Rightarrow 3 + 2 == 6 - 2 + 1$

$\Rightarrow 5 == 6 - 2 + 1$

$\Rightarrow 5 == 4 + 1$

$\Rightarrow 5 == 5$

$\Rightarrow \boxed{1}$

Assignment : Evaluate the expression $a - b \,||\, (a - b \times c) + d \;\&\&\; e - f \% 3$

where $a = 8, b = 3, c = 2, d = 3, e = 2, f = 11$

Sol^n $a - b \,||\, (a - b \times c) + d \;\&\&\; e - f \% 3$ where

$\qquad a = 8, b = 3, c = 2, d = 3, e = 2, f = 11$

so $8 - 3 \,||\, (8 - 3 \times 2) + 3 \;\&\&\; 2 - 11\%3.$

$\quad = 8 - 3 \,||\, (8 - 6) + 3 \;\&\&\; 2 - 11\%3$

$\quad = 8 - 3 \,||\, 2 + 3 \;\&\&\; 2 - 11\%3$

$\quad = 8 - 3 \,||\, 2 + 3 \;\&\&\; 2 - 2$

$\quad = 5 \,||\, 2 + 3 \;\&\&\; 2 - 2$

$\quad = 5 \,||\, 5 \;\&\&\; 2 - 2$

$\quad = 5 \,||\, 5 \;\&\&\; 0$

$\quad = 5 \,||\, 0$

$\quad = \boxed{1}$

<u>Assignment</u> : Evaluate the expression

$$t = 2 * 3/4 + 4/4 + 8 - 2 + 5/8$$

Solⁿ $t = 2 * 3/4 + 4/4 + 8 - 2 + 5/8$

$\quad\quad = 2 * 3/4 + 4/4 + 8 - 2 + 5/8$

$\quad\quad = 6/4 + 4/4 + 8 - 2 + 5/8$

$\quad\quad = 1 + 4/4 + 8 - 2 + 5/8$

$\quad\quad = 1 + 1 + 8 - 2 + 5/8$

$\quad\quad = 1 + 1 + 8 - 2 + 0$

$\quad\quad = 2 + 8 - 2 + 0$

$\quad\quad = 10 - 2 + 0$

$\quad\quad = 8 + 0$

$\quad\quad = \boxed{8}$

<u>Assignment</u> : Evaluate the expression

$$KK = 3/2 * 4 + 3/8 + 3$$

Solⁿ $KK = 3/2 * 4 + 3/8 + 3$

$\quad\quad = 1 * 4 + 3/8 + 3$

$\quad\quad = 1 * 4 + 9/8 + 3$

$\quad\quad = 4 + 3/8 + 3$

$\quad\quad = 4 + 0 + 3$

$\quad\quad = 4 + 3$

$\quad\quad = 7$

$\Rightarrow \quad KK = \boxed{7}$