

APPLICATION OF STACKS -

- Evaluation of Arithmetic expression
- conversion from infix to postfix
- Evaluation of postfix
- conversion from infix to prefix
- evaluation of prefix.

Evaluation of Arithmetic Expression.

<u>Operators</u>	<u>Precedence</u>	<u>Associativity</u>
→ Exponential (^)	6	right to left
→ Multiplication (*) Division (/)	5	left to right
→ addition (+) subtraction (-)	4	left to right
→ $>, <, \leq,$ $\geq, !=$	3	left to right
→ AND	2	left to right
→ OR, X-OR	1	left to right

Remark :- Higher numerical value will be highest precedence.

Example :- for evaluation of arithmetic expression

$$A + B * C / D - E \wedge F * G$$

The expression is annotated with numbers 1 through 6 to show operator precedence:

- 1: \wedge (Exponentiation)
- 2: $*$ and $/$ (Multiplication and Division)
- 3: $+$ and $-$ (Addition and Subtraction)
- 4: A , B , C , D , E , F , G (Operands)

Ques) evaluate following expression. $21^4 + 6 * 212 - 12/4$

$$\begin{aligned} & 21^4 + 6 * 212 - 12/4 \\ = & 214 + 6 * 212 - 12/4 \\ = & 16 + 6 * 24 - 12/4 \\ = & 16 + 24 - 3 \\ = & 40 - 3 \\ = & 37 \quad \text{Ans.} \end{aligned}$$

The expression is annotated with numbers 1 through 6 to show operator precedence:

- 1: $^$ (Exponentiation)
- 2: $*$ and $/$ (Multiplication and Division)
- 3: $+$ and $-$ (Addition and Subtraction)
- 4: 21 (Operands)

NOTATIONS FOR ARITHMETIC EXPRESSION :-

In arithmetic expression there are 3 notations are used :-

- (i) infix :- In this case the operator will be present in between two operands.
example - $A + B$.

(ii) Prefix:- In this Notation the operator present before the two operands.

Eg :- + A B

(iii) Postfix:- In this notation operator will be present after the operands.

Eg :- A B +

• conversion from Infix to Postfix-

Rule 1 :-

To convert infix to postfix we require 3 columns -

(i) symbol

(ii) stack

(iii) expression.

Rule 2 :-

If open parenthesis and operator is scanned then send it to stack column.

Rule 3 :-

If an operand is scanned then transfer it to the expression column.

Rule 4 :-

If a lower operator is present then a higher operator must be present on it, but if a higher operator is present in the stack and a lower operator is present in the stack on a encountered then the higher operator will be popped from the stack.

and it will transfer to the expression column and this process will continue until an open parenthesis or a lower operator is encountered.

Rule 5 :-

If a closed parenthesis is encountered then all the operators popped until it encountered an open parenthesis.

NOTE :- Insert closing parenthesis at the end.

Ques) convert from infix to postfix :-

A + (B * C - (D / E A F) * G) * H

<u>SYMBOL</u>	<u>STACK</u>	<u>EXPRESSION</u>
A		A
+	+	A
(+ (A
B	+ (C	AB
*	+ (C *	AB
C	+ (C *	ABC
-	+ (C -	ABC *
(+ (C - (ABC *
D	+ (C - (C	ABC * D
/	+ (C - (C /	ABC * D
E	+ (C - (C /	ABC * D E
^	+ (C - (C / ^	ABC * D E
F	+ (C - (C / ^	ABC * DEF
)	+ (C -	ABC * DEF A /
*	+ (C - *	ABC * DEF A /
G	+ (C - *	ABC * DEF A / G

)	+	$ABC * DEF \wedge G * -$
*	+ *	$ABC * DEF \wedge G * -$
H	+ *	$ABC * DEF \wedge G * - H$
)	*	$ABC * DEF \wedge G * - H * t$

Ques) $((A+B)/D) \uparrow ((E-F)*G)$

<u>S Y M B O L</u>	<u>STACK</u>	<u>EXPRESSION</u>
((
(((
A	((A
+	((+	A
B	((+	AB
)	(AB +
/	(/	AB +
D	(/	AB + D
)		AB + D /
\uparrow	\uparrow	AB + D /
($\uparrow ($	AB + D /
($\uparrow (($	AB + D /
E	$\uparrow (($	AB + D / E
-	$\uparrow ((-$	AB + D / E
F	$\uparrow ((-$	AB + D / E F
)	$\uparrow ($	AB + D / E F -
*	$\uparrow (*$	AB + D / E F -
G	$\uparrow (*$	AB + D / E F - G
)	\uparrow	AB + D / E F - G *
)		AB + D / E F - G * \uparrow

Ques) $(A - B) / ((D + E) * F)$

Q1
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<u>Symbol</u>	<u>stack</u>	<u>Expression</u>
((
A	(A
-	(-	A
B	(-	AB
)		AB-
/	/	AB-
(/()	AB-
(/()()	AB-
D	/()()	AB-D
+	/()()+	AB-D
E	/()()+	AB-DE
)	/()	AB-DE+
*	/()*	AB-DE+
F	/(*)	AB-DE+F
)	/	AB-DE+F*
)		AB-DE+F*

Ques) $((A + ((B \wedge C) - D)) * (E - (A / C)))$

<u>Symbol</u>	<u>stack</u>	<u>Expression</u>
((
)	()	
A	()	A
+	()+	A
(()+()	A*
(()+()	A
B	()+()	AB
\wedge	()+() \wedge	AB
C	()+() \wedge	ABC

)	$((+())$	$ABCA$
-	$((+(-))$	$ABCDA$
D	$((+(-))$	$ABCAD$
)	$((+)$	$ABCAD-$
)	$($	$ABCAD-+$
*	$\{ *$	$ABCAD-+$
($(*()$	$ABCAD-+$
E	$(*()$	$ABCAD-+E$
-	$(*()-)$	$ABCAD-+E$
($(*()-()$	$ABCAD-+E$
A	$(*()-()$	$ABCAD-+EA$
/	$(*()-()-)$	$ABCAD-+EA$
C	$(*()-()-()$	$ABCAD-+EAC$
)	$(*()-()$	$ABCAD-+EAC/$
)	$(*()$	$ABCAD-+EAC/-$
)		$ABCAD-+EAC/-*$

Ques) $((A+B)*D) \uparrow (E-F)$

symbol	stack	expression
((
(((
A	((A
+	((+)	A
B	((+)	AB
)	(AB+
*	(*	AB+
D	(*	AB+D
)		AB+D*
\uparrow	\uparrow	$AB+D*$
($\uparrow()$	$AB+D*$
E	$\uparrow()$	$AB+D*E$

-	$\uparrow (-$	$AB + D * E$
F	$\uparrow (-$	$AB + D * EF$
)	\uparrow	$AB + D * EF -$
)	:	$AB + D * EF - \uparrow$

Ques) $(A - B) * (D / E)$

Symbol	Stack	Expression
((
A		A
-	(-	AB
B	(-	AB -
)		AB -
*	*	AB -
(* (AB -
D	* (AB - D
I	* (I	AB - DE
E	* (I	AB - DE
)	*	AB - DE
)		AB - DE *

• conversion from Infix to Prefix :-

Eg:- $A + B * C * (M * N \wedge P + T) - G \vee H$.

Note:- Process from right to left (\leftarrow).

Symbol	Stack	Expression
H		H
+	+	H
G	+	HG
-	+ -	HG
)	+ -)	HG

T	+ -)	HGT
+	+ -) +	HGT
P	+ -) +	HGTP
^	+ -) + ^	HGT ^P
N	+ -) + ^	HGT ^P N
*	+ -) + * *	HGT ^P N ^
M	+ -) + * *	HGT ^P N ^ M
(+ -) *	HGT ^P N ^ M * +
*	+ - * *	HGT ^P N ^ M * +
C	+ - * *	HGT ^P N ^ M * + C
*	+ - * *	HGT ^P N ^ M * + C
B	+ - * *	HGT ^P N ^ M * + CB
+	+ - +	HGT ^P N ^ M * + CB * *
A	+ - +	HGT ^P N ^ M * + CB * * A
(HGT ^P N ^ M * + CB * * A +

Ans :- + - + A * * B C + * M N P T G H

Ques) ((A + ((B*C) - D)) * (E - (A*C)))

Symbol	Stack	Expression
))	
)))	
))))	
C))))	C
/))))/	C A
A))))/	C A
())	C A /
-))-	C A /
E))-	C A / E
()	C A / E -
*) *	C A / E -
)) *)	C A / E -
)) *)()	C A / E -

D) *))	CA E - D
-) *)) -	CA E - D
)) *)) -)	CA E - D
C) *)) -)	CA E - DC
^) *)) -) ^	CA E - DC
B) *)) -) ^	CA E - DCB
() *)) -	CA E - DCB A
() *	CA E - DCB A -
+) *) +	CA E - DCB A -
A) *) +	CA E - DCB A - A
() *	CA E - DCB A - A +
(CA E - DCB A - A + *

ANS :- * + A - ^ B C D → E / A C

Evaluation of postfix expression :-

Ex :- 3, 16, 2, +, *, 12, 6, 1, -, ,)

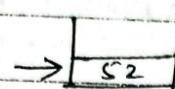
symbol	stack	value
3	→ [3]	-
16	→ [16 3]	-
2	→ [2 16 3]	-
+	→ [18 3]	$16 + 2 = 18$
*	→ [54]	$18 \times 3 = 54$
12	→ [12 54]	
6	→ [6 54]	

1



$$12/6 = 2$$

-



$$54 - 2 = 52$$

)

Ques) 12, 7, 3, -, 1, 2, 1, 5, +, *, +

symbol	stack	value
12	$\rightarrow \boxed{12}$	-
7	$\rightarrow \boxed{7}$	-
3	$\rightarrow \boxed{\frac{3}{7}}$	-
-	$\rightarrow \boxed{\frac{4}{12}}$	$7 - 3 = 4$
1	$\rightarrow \boxed{3}$	$12 / 3 = 4$
2	$\rightarrow \boxed{\frac{2}{3}}$	-
1	$\rightarrow \boxed{\frac{2}{\frac{2}{3}}}$	-
5	$\rightarrow \boxed{\frac{5}{\frac{2}{3}}}$	-
+	$\rightarrow \boxed{\frac{6}{\frac{2}{3}}}$	$5 + 1 = 6$
*	$\rightarrow \boxed{\frac{12}{\frac{2}{3}}}$	$6 * 2 = 12$
+	$\rightarrow \boxed{15}$	$12 + 3 = 15$

• Evaluation of prefix expression :-

$- * 3 + 16 \alpha / 12, 6$:	
symbol	stack	value
6	$\rightarrow [6]$	-
12	$\rightarrow [12]$	-
/	$\rightarrow [2]$	$12/6 = 2$
2	$\rightarrow [2]$	-
16	$\rightarrow [16]$	-
+	$\rightarrow [18]$	$16+2=18$
3	$\rightarrow [3]$	-
*	$\rightarrow [54]$	$18 \times 3 = 54$
-	$\rightarrow [52]$	$54 - 2 = 52$