

Postfix

$$A + B = AB +$$

Prefix

$$+ AB$$

$$(A+B) * C = [AB+] * C = AB+C*$$

$$A + (B * C) = A + (BC*) = ABC*+$$

### Evaluation of Postfix Expressions

1. Scan P from left to right and repeat 2-3 until end of the expression.
2. If an operand seen Push on to Stack.
3. If an operator  $\oplus$  seen then
  - (a) Remove (Pop) two operands A and B from Stack.
  - (b) Evaluate  $B \oplus A$ .
  - (c) Push result on to Stack.End (If)
- End (Scan)
4. Pop the final value from the Stack.

## Arithmetic Expressions

operators and operands

operators have a precedence

Highest: Exponentiation ( $\uparrow$ )  
Next Highest: Multiplication ( $\times$ ), division ( $/$ )  
Lowest: Addition ( $+$ ) and Subtraction ( $-$ )

Example Evaluate

$$2 \uparrow 3 + 5 \times 2 \uparrow 2 - 12 / 6$$

$\uparrow$  Evaluated first

$$8 + 5 \times 4 - 12 / 6$$

$\times, /$  Evaluated Second.

$$8 + 20 - 2$$

$+, -$  Evaluated next

$$26$$

Note operations of the same level are evaluated from left to right.

Types

Inflix

$$A + B$$

$$G / H$$

$$(A + B) \times C$$

$$A + (B \times C)$$

Prefix

$$+ A B$$

$$/ G H$$

$$(A + B) \times C = (+ A B) \times C = \times + A B C$$

$$A + (B \times C) = A + (\times B C) = + A \times B C$$

$$(A + B) / (C - D) = [+ A B] / [- C D] = / + A B - C D$$

## Transforming Infix Expressions into Postfix Expressions

Q  $\leftarrow$  infix expression

P  $\leftarrow$  postfix expression

1. Push '(' onto STACK, and add ')' to the end of Q.
  2. Scan Q left to right and repeat 3 to 6 until STACK is empty.
  3. If an operand is seen add it to P
  4. If a '(' is seen push it onto STACK.
  5. If an operator  $\otimes$  is seen then:
    - (a) Repeatedly pop from STACK and add to P operators with same or higher precedence than  $\otimes$
    - (b) Push  $\otimes$  to STACK.Endif.
  6. If a ')' is encountered then:
    - (a) Repeatedly pop from STACK and add to P each operator until a left parenthesis '(' is seen
    - (b) Discard '('.Endif
- End Scan.
7. Exit.

# Example

$$Q: A + (B * C - (D / E \uparrow F) * G) * H$$

$$Q. \quad A \quad + \quad ( \quad B \quad * \quad C \quad - \quad ( \quad D \quad / \quad E \quad \uparrow \quad F \quad ) \quad * \quad G \quad ) \quad * \quad H$$

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19)

Symbol Scanned	STACK	P
(1) A	(	A
(2) +	(+	A
(3) (	(+(	A
(4) B	(+(	AB
(5) *	(+(*	AB
(6) C	(+(*	ABC
(7) -	(+(-	ABC*
(8) (	(+(-(	ABC*
(9) D	(+(-(	ABC*D
(10) /	(+(-( /	ABC*D
(11) E	(+(-( /	ABC*DE
(12) ↑	(+(-( / ↑	ABC*DE
(13) F	(+(-( / ↑	ABC*DEF
(14) )	(+(-	ABC*DEF↑ /
(15) *	(+(- *	ABC*DEF↑ /
(16) G	(+(- *	ABC*DEF↑ / G
(17) )	(+	ABC*DEF↑ / G*-
(18) *	(+*	ABC*DEF↑ / G*-
(19) H	(+*	ABC*DEF↑ / G*-H
(20) )	_____	ABC*DEF↑ / G*-H*+