### Connection

You may have heard of parse trees: rooted trees that represent the syntactic structure of a string according to a context-free grammar. Even if you haven’t heard of parse tree, they can make sense of the relationship between prefix, infix, and postfix notation, and are somewhat intuitive. For example:

\[ (A+B)/C \]

As you might expect, a problem involves results in prefix notation, an integer involves results in prefix notation, and a problem involves results in postfix notation.

### Example

Convert the following prefix expression into infix:

\[ A + B * C / \]

Translate the formula back to infix:

\[ 4/3 \pi \times R^3 \times 1/3 \pi \times R^3 \]

### Practice

Convert the following infix expression into prefix: \(AB + (D - E)C\)

\[ / * A + B - D C A - B \]

Find all integer values of \(x\) for which the following prefix expression has a value of 0:

\[ x + y - 2 - x \]

### Example

If \(A = 7, B = 9, C = 3, D = 4, E = 6, \) and \(F = 8,\)

\[ \text{evaluate the following postfix expression:} \]

\[ AB C D E F + \]

### Fixing it up

Prefix, infix, postfix notation is a notation system that expresses operations in a different order. Prefix notation, also known as Polish notation, is often used in programming languages because it can be easily evaluated in a tree structure.

### Prefix

Prefix notation, also called Polish notation, is a way to write expressions in which operators are placed before operands. Prefix notation is used as a syntax for programming language interpreters because it can easily be parsed into a tree structure.

Prefix notation uses two operators, one to denote addition and one to denote subtraction. These operators are assumed to be the only ones allowed in the expression.

### Postfix

Postfix notation, also called reverse Polish notation, is quite similar to prefix notation. The difference is that instead of placing operators immediately before their operands, postfix places operators immediately after their operands. Postfix is used for the same reason prefix is used: to avoid ambiguity in the order the operations are performed.

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