Chapter 12 Case Study: The Polish Notation

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13.1 The Problem

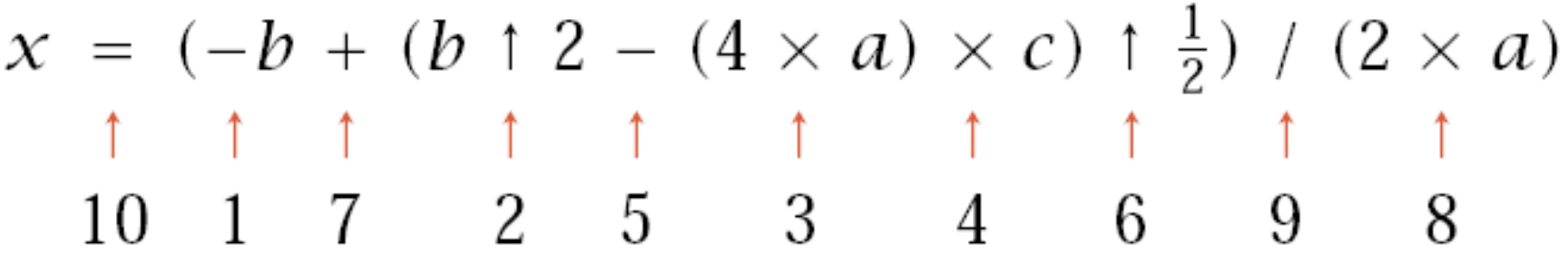
It was a real triumph to design a compiler that understood expressions such as

$$(x + y) * \exp(x - z) - 4.0$$
$$a * b + c/d - c * (x + y)$$
$$!(p \&\& q) \;||\; (x <= 7.0)$$

In fact, the name FORTRAN stands for

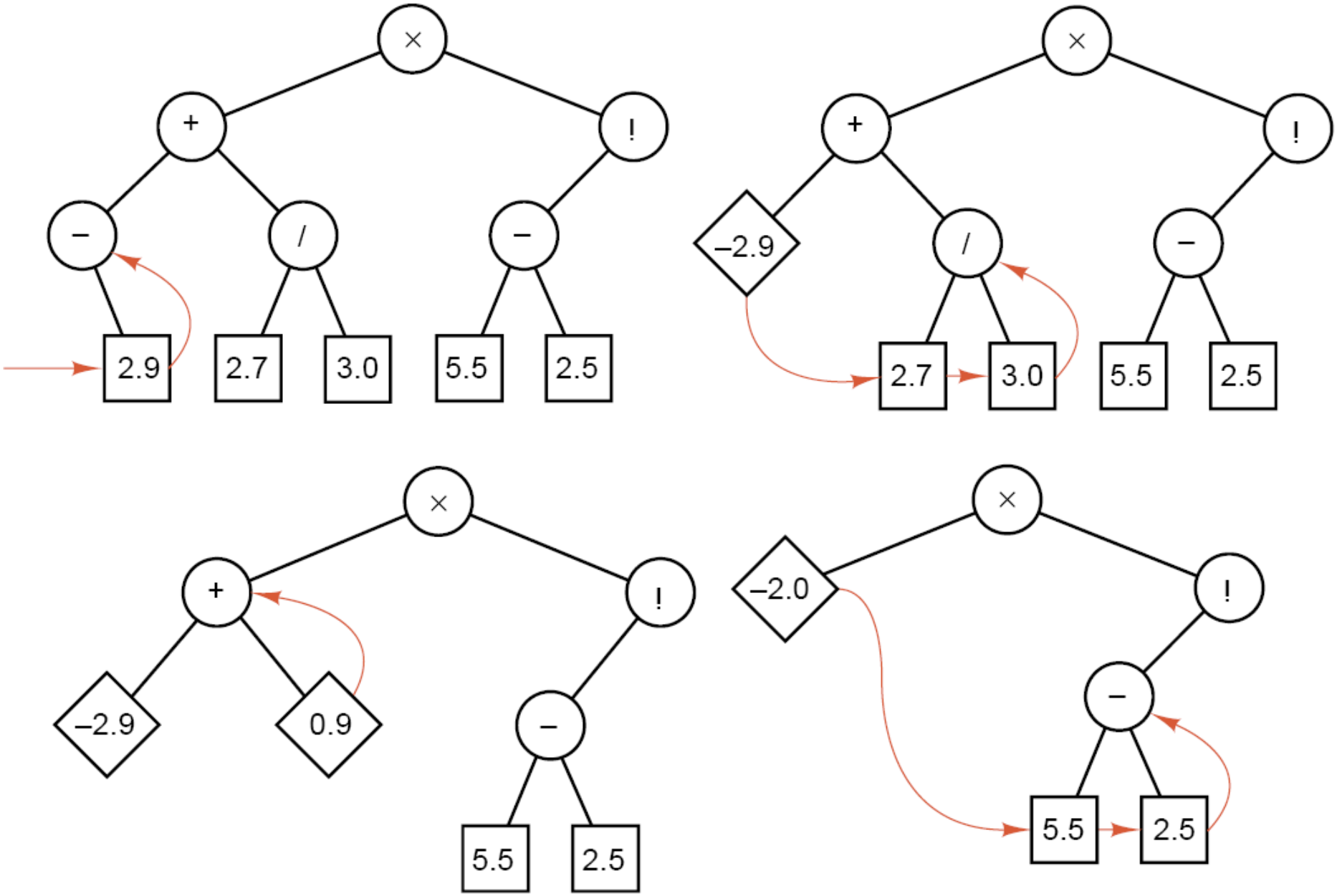
FORmula TRANslator

13.1.1 The Quadratic Formula

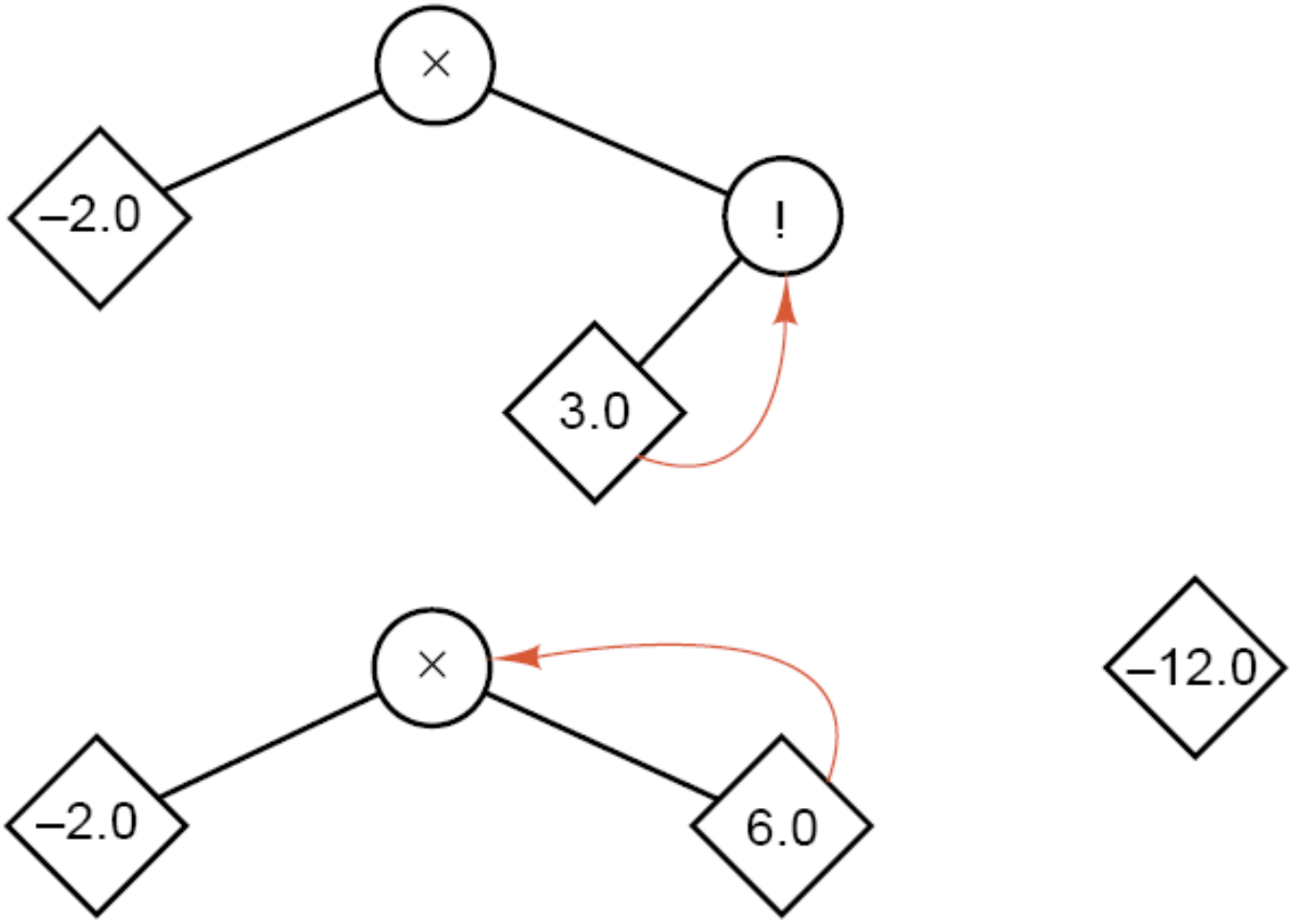


Operators	*Priority*
↑, all unary operators	6
× / %	5
+ − (binary)	4
== ! = < > ≤ ≥	3
not	2
&& ||	1
=	0

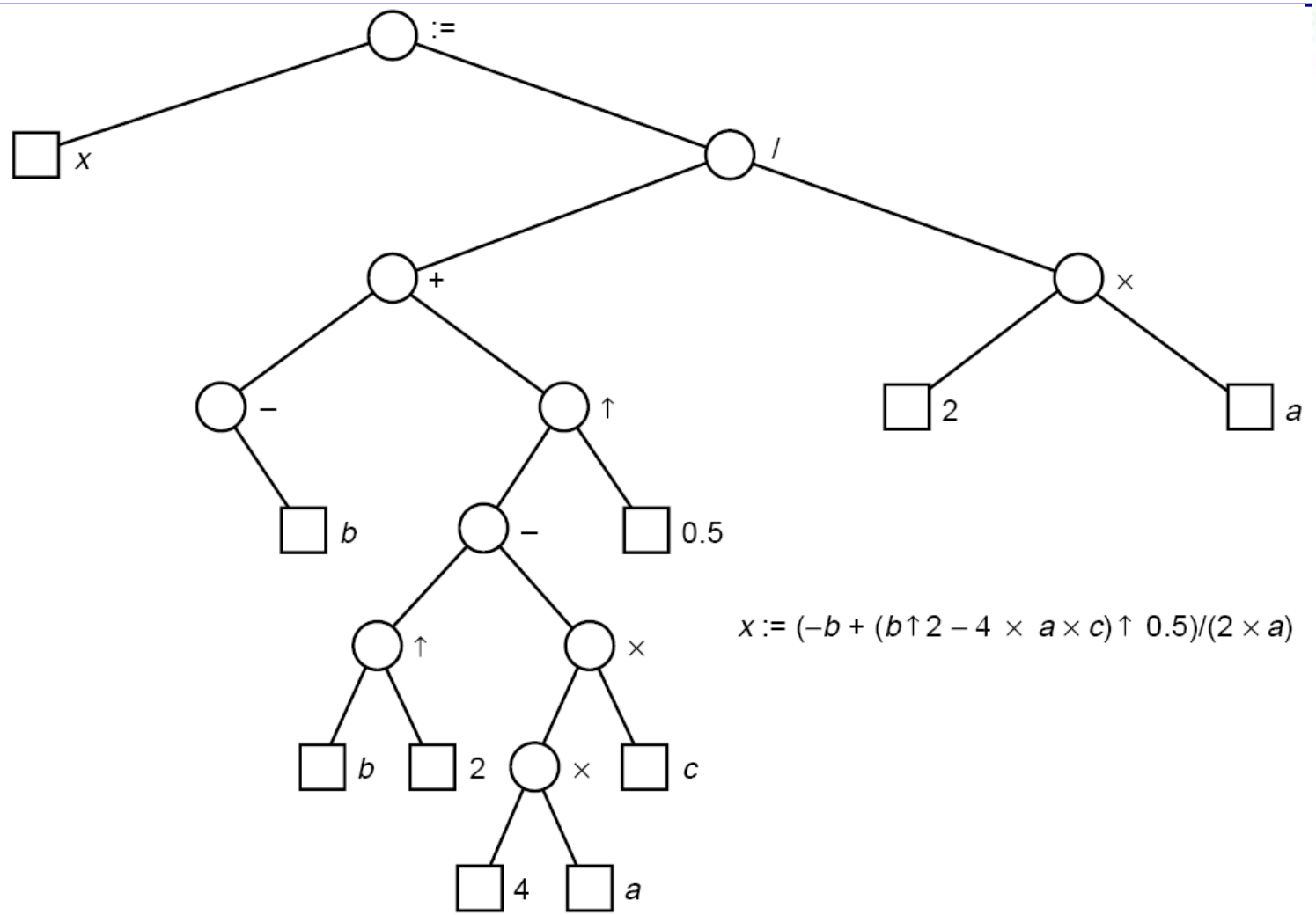
13.2.1 Expression Trees



13.2.1 Expression Trees



13.2.2 Polish Notation



$x := (-b + (b \uparrow 2 - 4 \times a \times c) \uparrow 0.5)/(2 \times a)$

Hence the complete prefix form for the quadratic formula is

$$= \quad x \quad / \quad + \quad \sim \quad b \quad \uparrow \quad - \quad \uparrow \quad b \quad 2 \quad \times \quad \times \quad 4 \quad a \quad c \quad \tfrac{1}{2} \quad \times \quad 2 \quad a.$$

You should verify yourself that the postfix form is

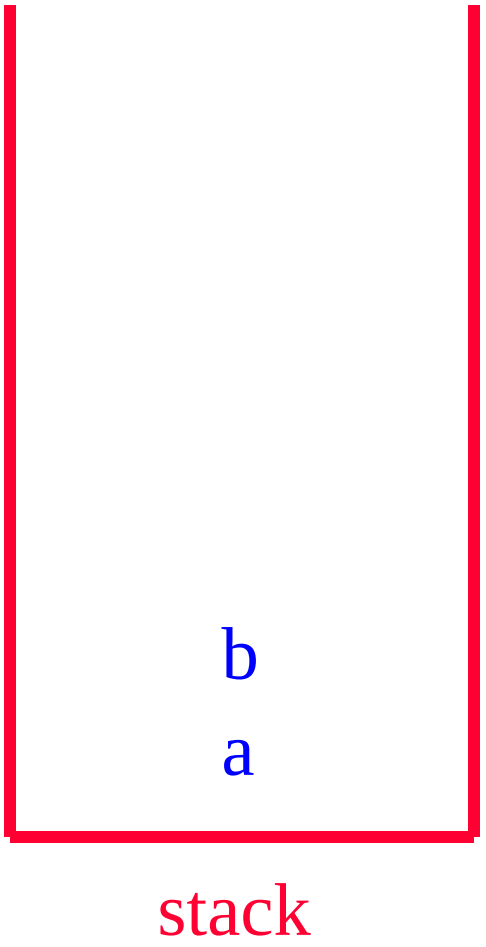
$$x \quad b \quad \sim \quad b \quad 2 \quad \uparrow \quad 4 \quad a \quad \times \quad c \quad \times \quad - \quad \tfrac{1}{2} \quad \uparrow \quad + \quad 2 \quad a \quad \times \quad / \quad = .$$

13.3.4 Evaluation of Postfix Expressions

- Scan postfix expression from left to right pushing operands on to a stack.
- When an operator is encountered, pop as many operands as this operator needs; evaluate the operator; push the result on to the stack.
- This works because, in postfix, operators come immediately after their operands.

Postfix Evaluation

- (a + b) * (c – d) / (e + f)
- a b + c d - * e f + /
- a b + c d - * e f + /
- a b + c d - * e f + /
- a b + c d - * e f + /



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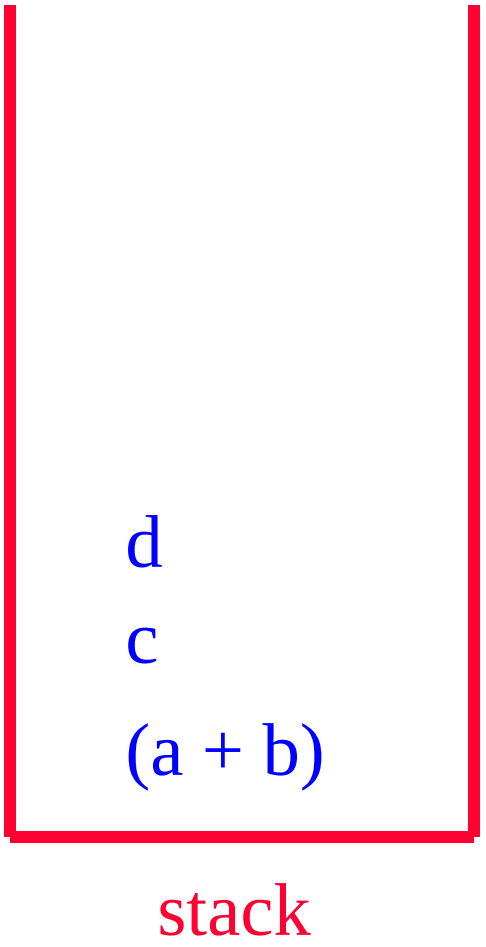

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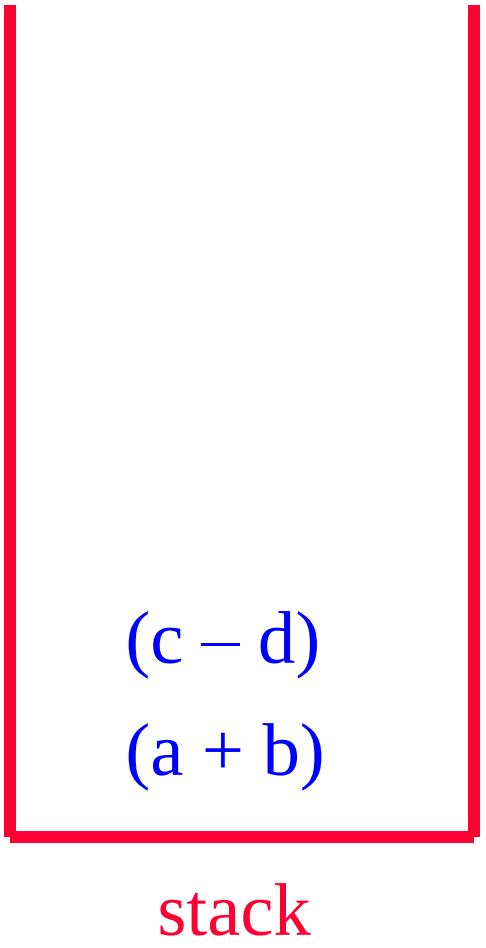

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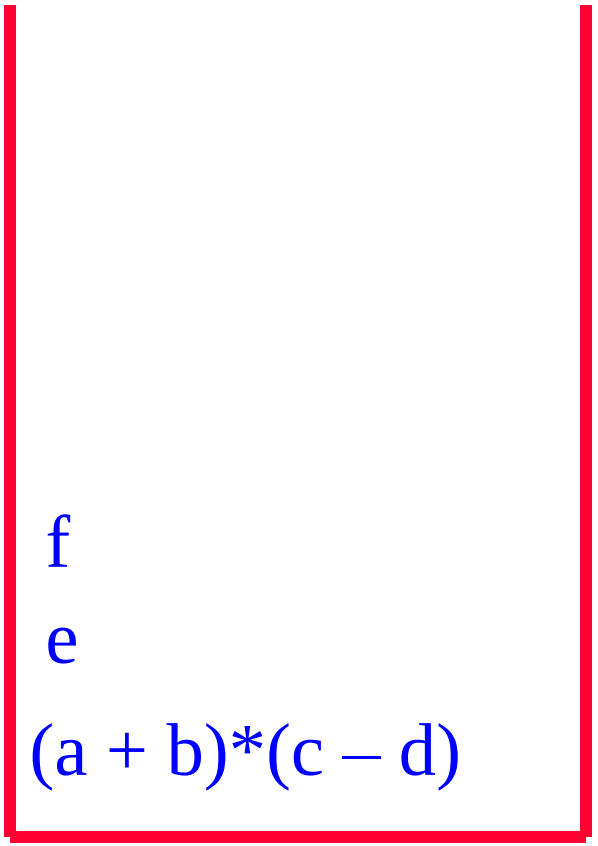

stack

Postfix Evaluation

- (a + b) * (c – d) / (e + f)
- a b + c d - * e f + /
- a b + c d - * e f + /
- a b + c d - * e f + /
- a b + c d - * e f + /
- a b + c d - * e f + /
- a b + c d - * e f + /