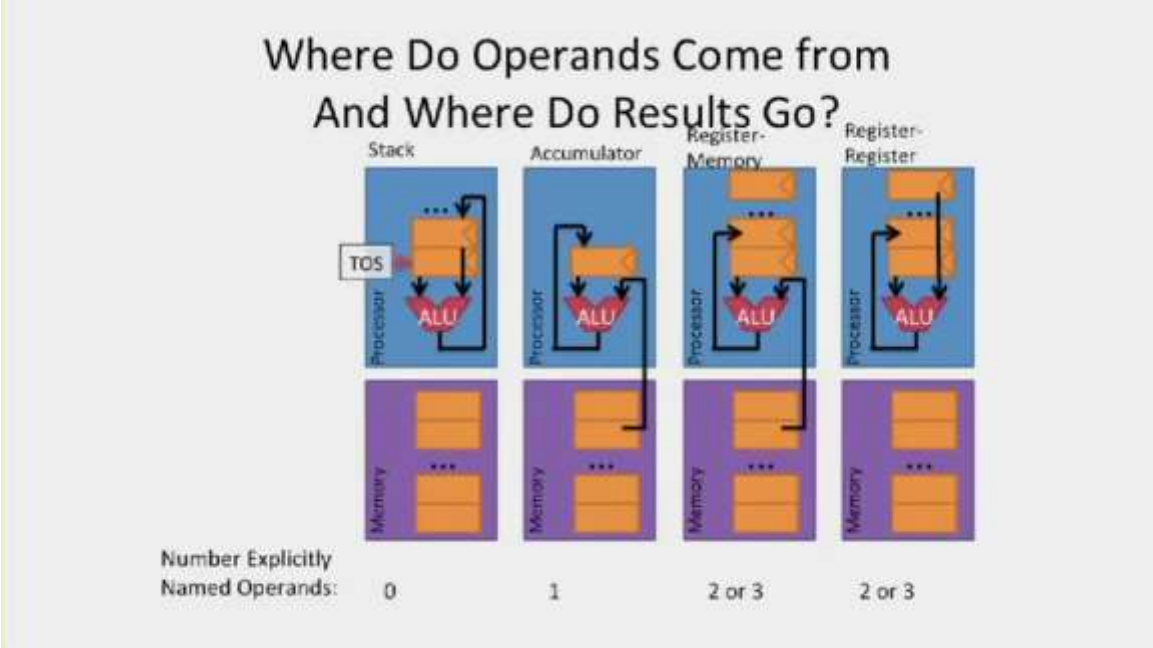
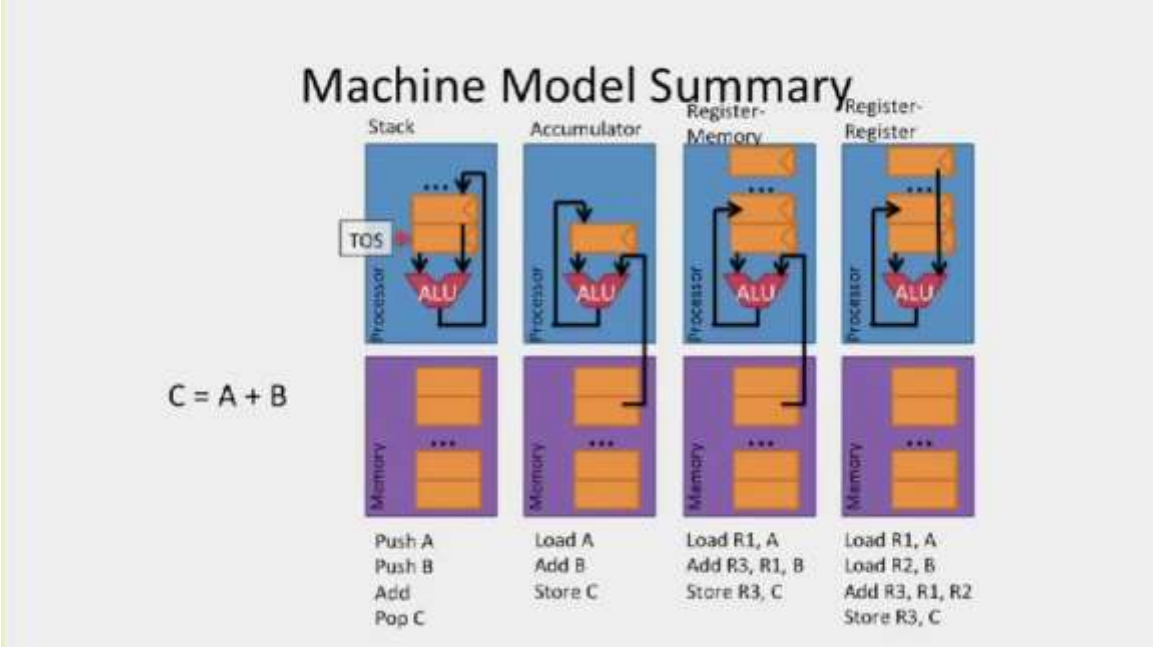
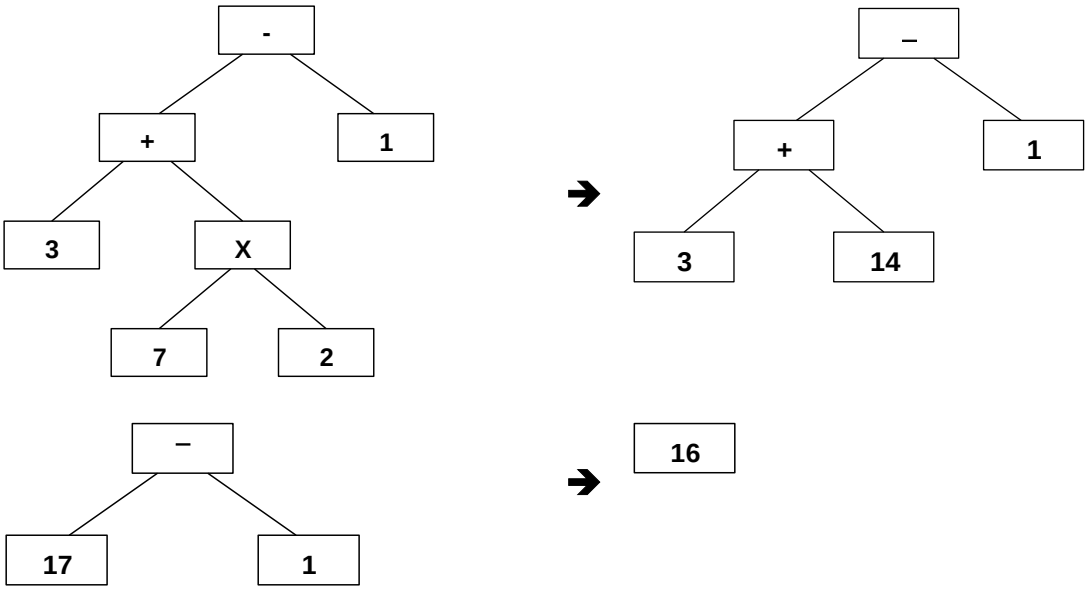
Competitive programing / Performance enhancements

x++ (inc) …..faster than x+=1 (add 1) ….faster than x=x+1 (mov, add, store)





Expression tree for $3 + 7 \times 2 - 1$ = **- + 3 × 7 2 1**



Create an expression tree for the following expression: 6 * 4 / 2 + 7 - 5 * 3

Reverse Polish Notation (RPN)

You will learn how to use a stack ADT to evaluate a mathematical expression written in reverse Polish notation (RPN= postfix notation).

(A+B)*C AB+C*

infix postfix

Notice that the **postfix** expression **HAS NO AMBIGUITY**, so it does not need **parentheses** to ensure that A+B is computed before the multiplication of C.

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

(AB+)*(CD+)/(EF-)

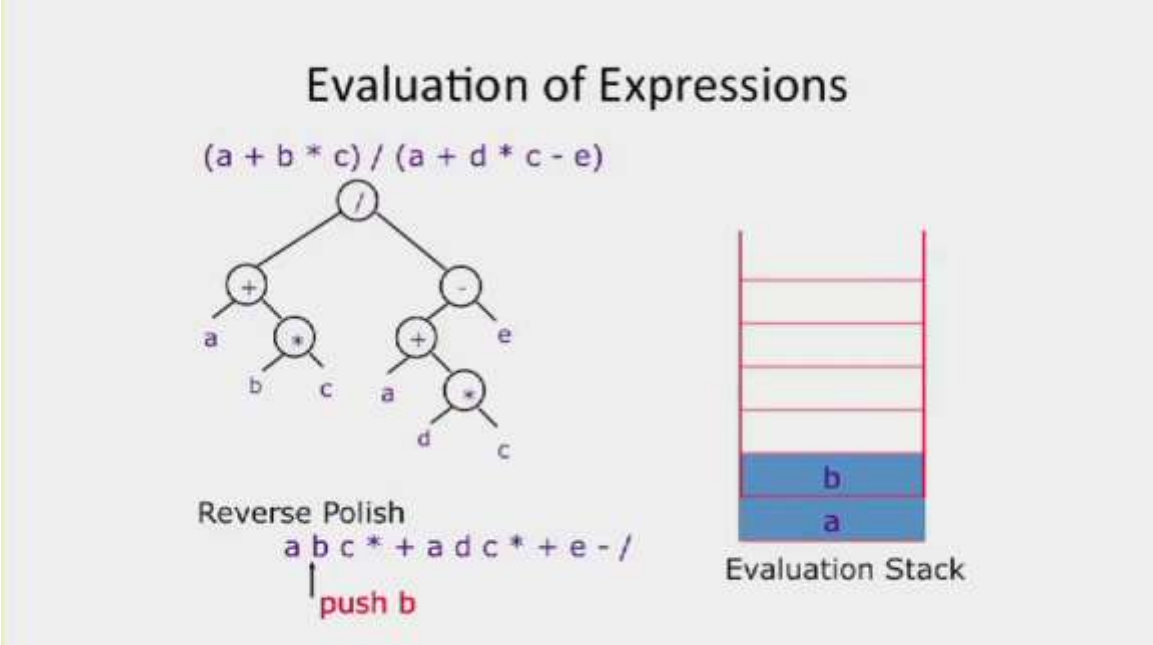
(AB+CD+*)/(EF-)

AB+CD+*EF-/

We can use a stack to evaluate a postfix expression in the following algorithm.
Scanning from left to right when we encounter an operand we push its value onto a stack. When we encounter a binary (two operand) operator we pop two values off the stack, perform the indicated operation and then push the result back onto the stack. When we are finished we can pop the stack to get the final result.

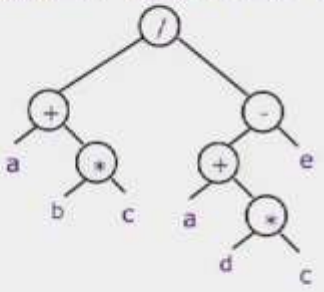
Enter values for three variables A=1, B=2 and C=3.

AB+C*	AB+C*	AB+C*	AB+C*	AB+C*
1	2 1	3	3 3	9
push A	push B	pop B pop A push A+B	push C	pop C pop A+B push (A+B)*C



Evaluation of Expressions

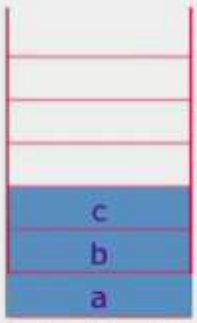
(a + b * c) / (a + d * c - e)



Reverse Polish

a b c * + a d c * + e - /

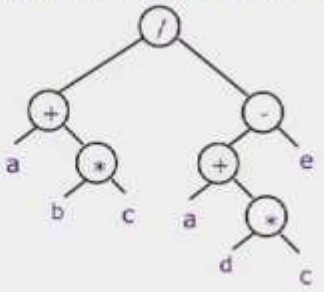
push c



Evaluation Stack

Evaluation of Expressions

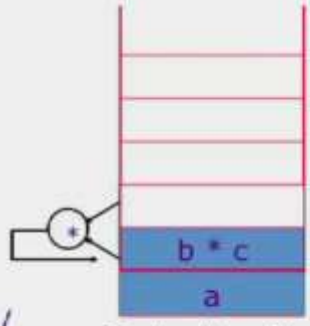
(a + b * c) / (a + d * c - e)



Reverse Polish

a b c * + a d c * + e - /

multiply



Evaluation Stack

"Iron Law" of Processor Performance

$$\frac{\text{Time}}{\text{Program}} = \frac{\text{Instructions}}{\text{Program}} * \frac{\text{Cycles}}{\text{Instruction}} * \frac{\text{Time}}{\text{Cycle}}$$

- Instructions per program depends on source code, compiler technology, and ISA
- Cycles per instructions (CPI) depends upon the ISA and the microarchitecture
- Time per cycle depends upon the microarchitecture and the base technology

Microarchitecture	CPI	cycle time
Microcoded	>1	short
Single-cycle unpipelined	1	long
Pipelined	1	short