Lecture # 6

Stack: Array or List

- Since both implementations support stack operations in constant time, any reason to choose one over the other?
- Allocating and deallocating memory for list nodes does take more time than preallocated array.
- List uses only as much memory as required by the nodes; array requires allocation ahead of time.
- List pointers (head, next) require extra memory.
- Array has an upper limit; List is limited by dynamic memory allocation.

Implmentation Issues/Discussion in C/C++

- Stack – push() operation
- Stack – pop() operation
- Stack – Is_Full() operation
- Stack – Is_Empty() operation

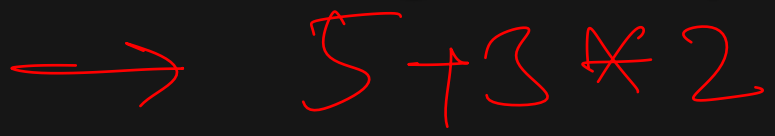
Uses of Stack

Use of Stack

- Example of use: prefix, infix, postfix expressions.
- Consider the expression A+B: we think of applying the *operator* "+" to the *operands* A and B.
- "+" is termed a *binary operator*: it takes two operands.
- Writing the sum as A+B is called the *infix* form of the expression.

Prefix, Infix, Postfix

- Two other ways of writing the expression are



+ A B	*prefix*
A B +	*postfix*

- The prefixes “pre” and “post” refer to the position of the operator with respect to the two operands.

Prefix, Infix, Postfix

- Consider the infix expression

  A + B * C
- We "know" that multiplication is done before addition.
- The expression is interpreted as

  A + (B * C)
- Multiplication has *precedence* over addition.

Prefix, Infix, Postfix

- Conversion to postfix

A + (B * C)	infix form
A + (B C *)	convert multiplication
A (B C *) +	convert addition
A B C * +	postfix form

Prefix, Infix, Postfix

- Conversion to postfix

(A + B) * C	infix form
(A B +) * C	convert addition
(A B +) C *	convert multiplication
A B + C *	postfix form

Precedence of Operators

- The five binary operators are: addition, subtraction, multiplication, division and exponentiation. The order of precedence is (highest to lowest)
- Exponentiation ↑
- Multiplication/division *, /
- Addition/subtraction +, -

Precedence of Operators

- For operators of same precedence, the left-to-right rule applies:

  A+B+C means (A+B)+C.

- For exponentiation, the right-to-left rule applies

  $A \uparrow B \uparrow C$ means $A \uparrow (B \uparrow C)$

Infix to Postfix

Infix	Postfix
A + B	A B +
12 + 60 – 23	12 60 + 23 –
(A + B)*(C – D)	A B + C D – *
A ↑ B * C – D + E/F	A B ↑ C*D – E F/+

Infix to Postfix

- Note that the postfix form an expression does not require parenthesis.
- Consider ‘4+3*5’ and ‘(4+3)*5’. The parenthesis are not needed in the first but they are necessary in the second. The postfix forms are:

4+3*5	435*+
(4+3)*5	43+5*

Evaluating Postfix

- Each operator in a postfix expression refers to the previous two operands.
- Each time we read an operand, we push it on a stack.
- When we reach an operator, we pop the two operands from the top of the stack, apply the operator and push the result back on the stack.

Evaluating Postfix

- Evaluate: 6 2 3 + - 3 8 2 / + * 2 ↑ 3 +

Input	op1	op2	value	stack
6				6
2				6,2
3				6,2,3
+	2	3	5	6,5
-	6	5	1	1
3	6	5	1	1,3
8	6	5	1	1,3,8
2	6	5	1	1,3,8,2
/	8	2	4	1,3,4
+	3	4	7	1,7
*	1	7	7	7
2	1	7	7	7,2
↑	7	2	49	49
3	7	2	49	49,3
+	49	3	52	52