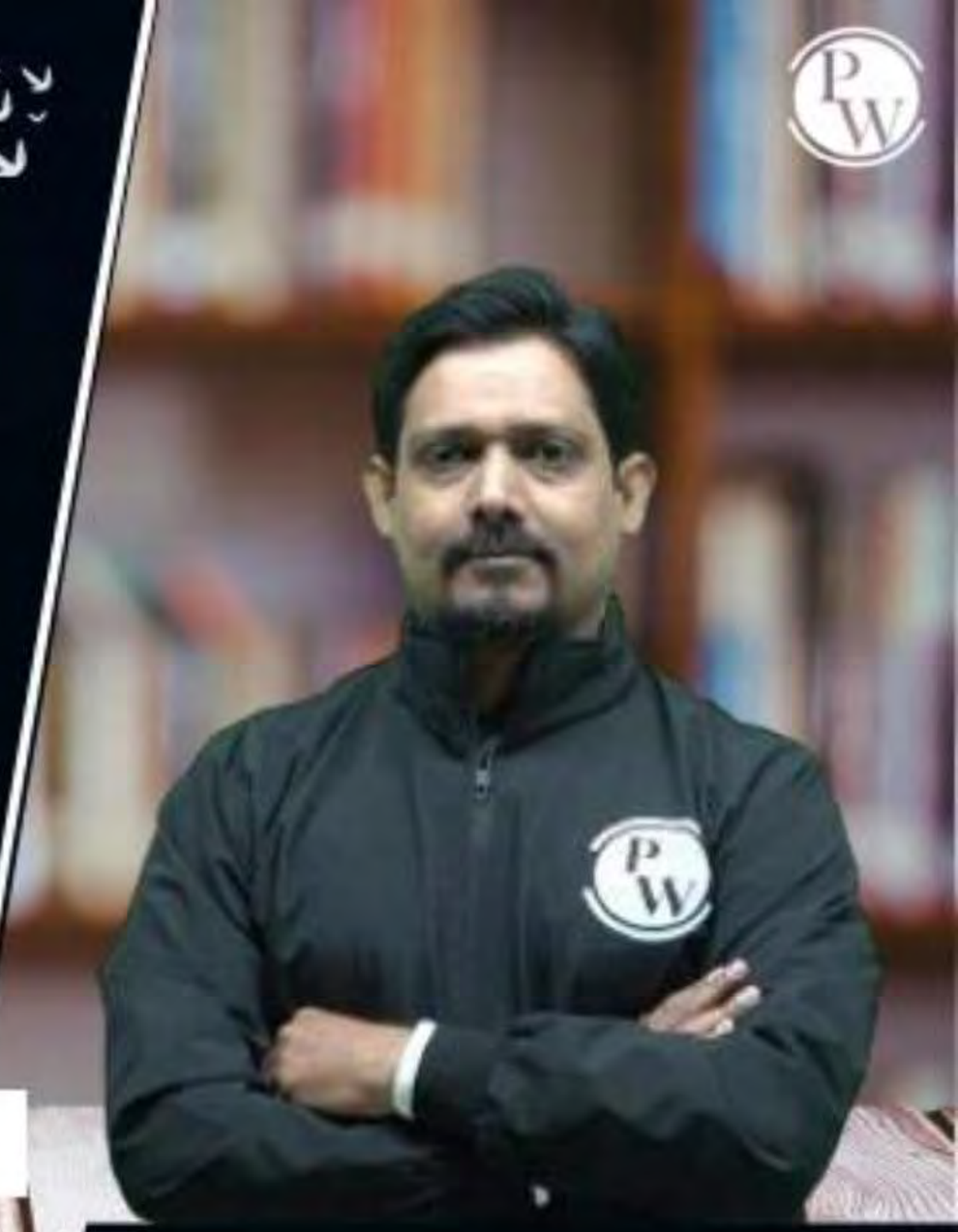
Computer Science & IT

Data Structure & Programming

Stack

Lecture No. 02



By- Abhishek Sir

Recap of Previous Lecture

- Topic
- Topic
- Topic
- Topic
- Topic

Stack Logical property

Stack Implementation

Slide

Topics to be Covered

- Topic — Stack Application
- Topic — Stack as permutation generator
- Topic — Expression in Computer : prefix, postfix, Infix
- Topic — * Recursion (Done)
- Topic

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Topic : Stack as Permutation Generator

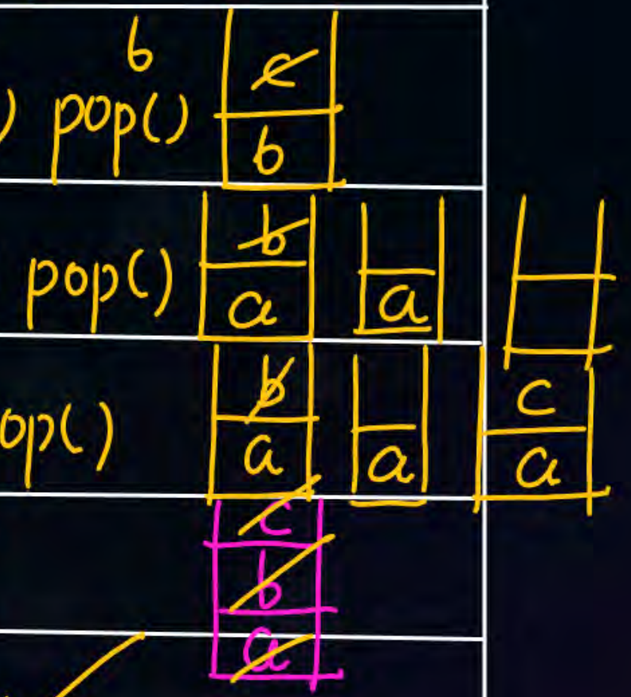
Suppose we consider letter a, b, c in the given order Stack can use to generate different permutation of a, b, c in following way The letter can be pushed in the given order in the stack but pop & print can happen anytime This property generate different permutation of a, b, c but due to logical property of stack certain permutation will Not be generated

Slide

Topic : Stack as Permutation Generator

a, b, c order is fixed, pop & print anytime (LIFO)

✓ abc	push(a) pop() push(b) pop() push(c) pop() (a, b, c)
✓ acb	push(a), pop(), push(b), push(c), pop() pop() (c, b)
✓ bac	push(a) push(b) pop() pop(), push(c) pop()
✓ bca	push(a) push(b) pop(), push(c) pop(), pop()
cab	push(a) push(b) push(c) pop() pop() ✗
cba	push(a) push(b) push(c) pop() pop() pop() ✓



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Topic : Stack as Permutation Generator

with 3 elements only 5 permutation possible

Slide

Topic : Stack as Permutation Generator

a, b, c, d

1 1

push(a), pop() b, c, d

a b c d ✓	b a c d	c a b d	d a b c ✗
a b d c ✓	b a d c	c a d b	d a c b ✗
a c b d ✓	b c a d	c b a d	d c a b ✗
a c d b ✓	b c d a	c b d a	d c b a ✓
a d b c ✗	b d a c	c d a b	d b a c ✗
a d c b ✓	b d c a	c d b a	d b c a ✗
5			

d
c
b
a

Slide

Topic : Stack as Permutation Generator

push(a) push(b) pop()

c, d

b

Total = 6 + 3 = 8 ✗

6 + 8 = (14)

(6)

b a c d ✓
b a d c ✓
b c a d ✓
b c d a
b d a c
b d c a ✓

(3)

c a b d a
c a d b a
c b a d ✓
c b d a ✓
c d a b a
c d b a ✓

push(a) push(b)

push(c) , pop()

(c)

Topic : Stack as Permutation Generator

(5)

b a c d ✓
b a d c ✓
b c a d ✓
b c d a
b d a c
b d c a ✓

(3)

c a b d ✗
c a d b ✗
c b a d ✓
c b d a ✓
c d a b ✗
c d b a ✓

push(a) push(b)

pop() , push(c) , push(d)

c, d

d
c
a

pop() , pop() , pop()

d c a

✗

push(a) push(b)

push(c) , pop()

c
b
a

b
a

c

Topic : Stack as Permutation Generator

(5)

b a c d
b a d c
b c a d
b c d a
b d a c
b d c a

(3)

c a b d
c a d b
c b a d
c b d a
c d a b
c d b a

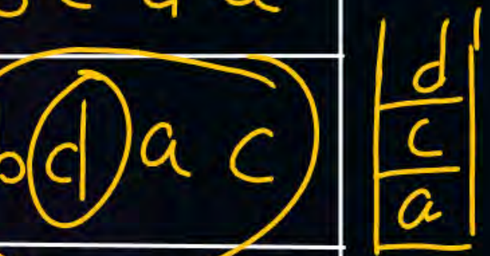
push(a) push(b)

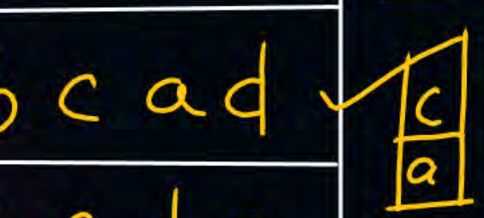
pop(), push(c), push(d)

c, d

pop(), pop(), pop()

d c a





push(a) push(b) push(c)

pop(), pop()

c

Topic : Stack as Permutation Generator

n	# of permutation
1	1
2	2
3	5
4	14
5	42
6	132

No of permutation generated by stack with n distinct letter is Catalan No

$$C_n = \frac{1}{n+1} {}^{2n}C_n$$

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Topic : Stack as Permutation Generator

$$C_5 = \frac{1}{6}\,{}^{10}C_5 = \frac{1}{6}\,\frac{\lfloor 10}{\lfloor 6 \lfloor 10-5}$$

$$= \frac{1}{6}\,\frac{\lfloor 10}{\lfloor 5 \times \lfloor 5}$$

$$= \frac{1}{6}\,\frac{10 \times 9 \times 8 \times 7 \times 6 \lfloor 5}{5 \times 4 \times 3 \times 2 \times 1 \lfloor 5}$$

$$= 42$$

$C_6 = ?$

$$\frac{1}{7}\,{}^{12}C_6 = \frac{1}{7} \times \frac{12 \times 11 \times 10 \times 9 \times 8 \times 7}{6 \times 5 \times 4 \times 3 \times 2 \times 1}$$

$$= 11 \times 12 = 132$$

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Topic : Stack as Permutation Generator

#Q The following sequence of operations is performed on a stack:

PUSH (10), PUSH (20), POP , PUSH (10), PUSH (20), POP, POP, POP, PUSH (20), POP

The sequence of values popped out is:

- 20, 10, 20, 10, 20
- 20, 20, 10, 10, 20
- 10, 20, 20, 10, 20
- 20, 20, 10, 20, 10

MSQ

A program attempts to generate as many permutations as possible of the string 'abcd' by pushing the characters a, b, c, d in the same order onto a stack, but it may pop off the top character at any time. Which one of the following strings CAN be generated using this program?

(A) abcd ✓

(b) dcba

(c) cbad

(d) cabd

cbad

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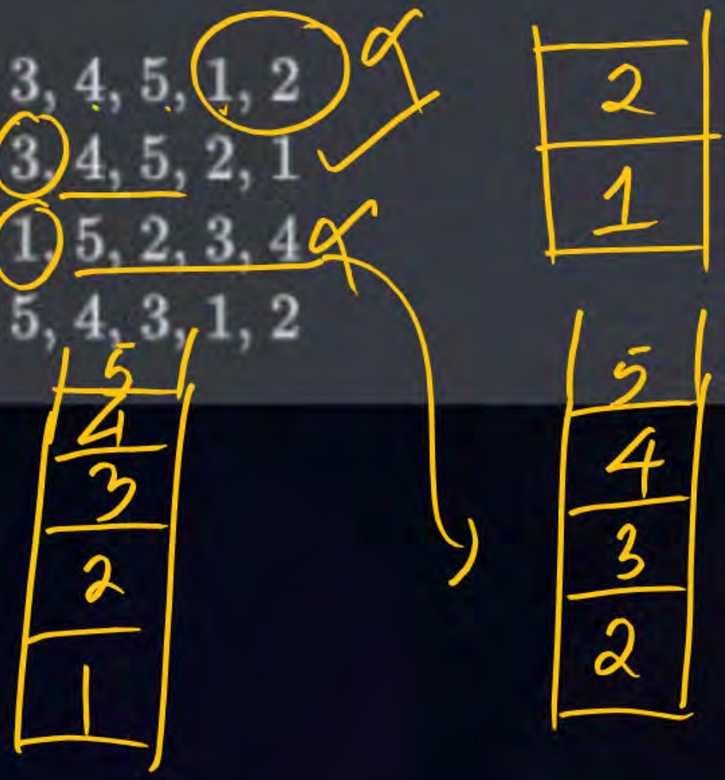
Topic : GATE 1994

Which of the following permutations can be obtained in the output (in the same order) using a stack assuming that the input is the sequence 1, 2, 3, 4, 5 in that order?

A. 3, 4, 5, 1, 2
B. 3, 4, 5, 2, 1
C. 1, 5, 2, 3, 4
D. 5, 4, 3, 1, 2



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Topic : Expression In Computer

Second Application of stack Expression

1 Infix a+b , 5+6

operand$_1$ operator operand$_2$

Variable name
2
Constant
} operand

2. polis Notation (prefix Notation) + operator

+ a b operator operand$_1$ operand$_2$

3 Reverse polish Notation (postfix Expression)

a b + operand$_1$ operand$_2$ operator

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Topic : Expression In Computer

Two Techniques

- precedence & Associativity
- precedence Associativity & Stack. — program for conversion

Topic : Expression In Computer

Associativity

Highest precedence	—	unary minus (-5)	
$2 \uparrow 3 = 2^3 = 8$	↑ or ^	Exponentiation	Right to left
	* or /		Left to Right
	(Binary)+ or −	5-6	Left to right
Lowest precedence	=	Assignment	Right to Left

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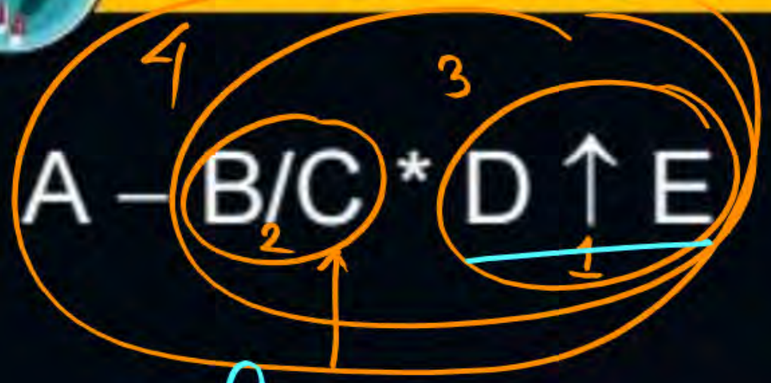
Topic : Expression In Computer



prefix

operand

A – B/C * ↑DE

= A – /BC * ↑DE

= A – *⁄BC↑DE

– A */BC↑DE

= A – B/C * DE↑

= A – BC/ * DE↑

= A – BC/DE↑*

= ABC/DE↑*–

Slide

Topic : Expression In Computer

A + B * C – D – E ↑ F + G

3 2 4 5 1 6

prefix :- = A + *BC – D – ↑EF + G

= +A*BC – D – ↑EF + G

= –+A*BCD – ↑EF + G

= – –+A*BCD↑EF + G

+ – – + A * BCD ↑ EFG

Slide

Topic : Expression In Computer

postfix

= A + BC* - D - EF↑ + G

= ABC*+ - D - EF↑ + G

= ABC*+D- - EF↑ + G

= ABC*+D-EF↑- + G

ABC*+D-EF↑-G+

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Topic : Expression In Computer

Assume that the operators + , – , ×, are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, x, +, – . The postfix expression corresponding to the infix expression a + b × c – d ^ e ^ f is

(A) abc × + def ^ ^ –

(B) abc × + de ^f ^ –

(C) ab + c × d – e ^ f ^

(D) – + a × bc ^ ^ def

$a + b^{3} \times c^{4} - d \wedge e^{2} \wedge f^{1}$

$= a + \underline{bc\times} - d \wedge ef \wedge$

$= a + bc\times - def \wedge\wedge$

$= abc\times + - def \wedge\wedge$

$= abc\times + def \wedge\wedge -$

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2 mins Summary

Topic

Topic

Topic

Topic

Topic

Stack as permutation generator

Expression in Computer

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t.me/Abhishekshaarmapw

THANK - YOU

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