NOTRE DAME UNIVERSITY BANGLADESH

Data Structure

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Subject: Data Structure

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Batch: CSE-19

① INSERT (LA, N, k, ITEM)

Here LA is a linear array with N elements and K is a positive integer such that $K \leq N$. This algorithm inserts an element ITEM into the Kth position in LA.

(1) [Initialize counter.] set J := N.
(2) Repeat Steps 3 and 4 while J ≥ k.
(3) Set LA [J+1] := LA [J].
(4) ~~Decre~~ Set J := J-1 [End of Step 2 loop].
(5) [Insert element.] set LA [K] := ITEM.
(6) [Reset N.] set N := N+1 (7) Exit.

② Binary search

1	2	3	4	5	6	7	8	9	10	11	12	13
5	8	9	12	15	19	25	30	35	46	51	65	80

(a) B = 1, E = 13

$\therefore m = \left\lfloor \frac{B+E}{2} \right\rfloor = \left\lfloor \frac{1+13}{2} \right\rfloor = 7$

Mid [7] = 25 ≠ item

B > item (19)

Set E = 7 - 1 = 6

(b) B = 1, E = 6

$m = \left\lfloor \frac{1+6}{2} \right\rfloor = 3.5 \approx 3$

Mid [3] = ~~10~~9 ≠ item

9 < item (19)

Set E = 3+1 = 4

(c) B = 4, E = 6

$\therefore m = \left\lfloor \frac{4+6}{2} \right\rfloor = 5$

∴ Mid [5] = 15 ≠ item

15 < item

B = 5+1 = 6

(d) B = 6, E = 6

$\therefore m = \left\lfloor \frac{6+6}{2} \right\rfloor$ = ~~8~~ 6

∴ Mid [6] = ~~2~~19 = item

∴ ~~2~~19 is found in index no. 6

(2.b) Bubble Sort 11, 45, 8, 35, 2, 7

K=1

(a) (11), (45), 8, 35, 2, 7

(b) 11, (45), (8), 35, 2, 7

=> 11, 8, 45, 35, 2, 7

(c) 11, 8, (45), (35), 2, 7

=> 11, 8, 35, 45, 2, 7

(d) 11, 8, 35, (45), (2), 7

=> 11, 8, 35, 2, 45, 7

(e) 11, 8, 35, 2, (45), (7)

=> 11, 8, 35, 2, 7, [45]

K=2

(a) (11), (8), 35, 2, 7, [45]

=> 8, 11, 35, 2, 7, [45]

(b) 8, (11), (35), 2, 7, [45]

(c) 8, 11, (35), (2), 7, [45]

=> 8, 11, 2, 35, 7, [45]

(d) 8, 11, 2, (35), (7), [45]

=> 8, 11, 2, 7, [35, 45]

K=3

(a) (8), (11), 2, 7, [35, 45]

(b) 8, (11), (2), 7, [35, 45]

~~(c)~~ => 8, 2, 11, 7, [35, 45]

(c) 8, 2, (11), (7), [35, 45]

=> 8, 2, 7, [11, 35, 45]

K=4

(a) (8), (2), 7, [11, 35, 45]

=> 2, 8, 7, [11, 35, 45]

(b) 2, (8), (7), [11, 35, 45]

=> 2, 7, [8, 11, 35, 45]

K=5

(a) (2), (7), [8, 11, 35, 45]

=> [2, 7, 8, 11, 35, 45]

(3) What is Stack? Give an example. Do the following operation using stack where MAX Items in the stack can be 6.

PUSH: A, B, C, D, E
POP
POP
PUSH: F, G, H, I
POP

Ans: A stack is a list of elements in which an element may be inserted or deleted only at one end. But it must be done on the top of the stack.

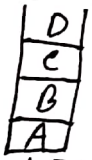
→ Push: To insert an element into a stack.
→ Pop: To delete an element from a stack.

a) PUSH: A
T = 0+1 = 1

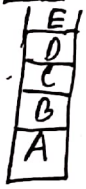
b) PUSH: B
T = 1+1 = 2

c) PUSH: C
T = 2+1 = 3

d) PUSH: D
T = 3+1 = 4

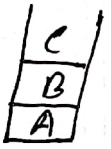


e) PUSH: E
T = 4+1 = 5



f) POP: ITEM
T = 5-1 = 4

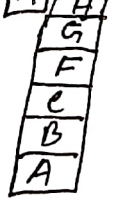
g) POP: ITEM
T = 4-1 = 3



h) PUSH: F
T = 3+1 = 4

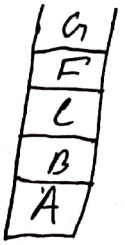
i) PUSH: G
T = 4+1 = 5

j) PUSH: H
T = 5+1 = 6



k) PUSH: ~~ITEM~~ T
T = 6+1 = 7
∵ MAX VALUE = 6
∴ STACK Overflow.

l) POP: ITEM
T = 6-1 = 5



④ Consider the following infix expression.
(25+(5-1)-3/(2*7)) Use stack to translate the given expression into its equivalent postfix expression P.

Ans:

Symbol Scanned	Stack	Expression P
(	(	
25		25
+	(+	25
(	(+(	25
5	(+(	25,5
-	(+(-	25,5
1	(+(-	25,5,1
)	(+	25,5,1-
-	(-	25,5,1-+
3	(-	25,5,1-+3
/	(-/	25,5,1-+3
(	(-/(	25,5,1-+3
2	(-/(	25,5,1-+3,2
*	(-/(*	25,5,1-+3,2
7	(-/(*	25,5,1-+3,2,7
)	(-/	25,5,1,-+3,2,7*
)		25,5,1,-+3,2,7*/-

① DELETE (LA, N, K, ITEM)

Here LA is a linear array with N elements and K is a positive integer such that $K \leq N$. This algorithm deletes the Kth element from LA.

(1) Set ITEM := LA[K].

(2) Repeat for J = K to N-1:

Set LA[J] := LA[J+1]. [End of loop]

(3) Set N := N-1. (4) Exit.

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② (Binary Search)

index →	1	2	3	4	5	6	7	8	9	10	11	12	13
	1	7	11	17	23	24	31	44	51	56	61	71	99

(a) B=1, E=13

$\therefore M = \left[\frac{B+E}{2}\right] = \left[\frac{1+13}{2}\right] = 7$

Mid[7] = 31 ≠ item

31 > item (24)

Set E = 7-1 = 6

(b) B = 1, E = 6

$M = \left[\frac{1+6}{2}\right] = 3.5 \approx 3$

Mid[3] = 11 ≠ item

11 < item (24)

B = 3+1 = 4

(c) B = 4, E = 6

$\therefore M = \left[\frac{4+6}{2}\right] = 5$

$\therefore$ Mid[5] = 23 ≠ item

23 < item

B = 5+1 = 6

(d) B = 6, E = 6

$\therefore M = \left[\frac{6+6}{2}\right] = 6$

$\therefore$ Mid[6] = 24 = item

$\therefore$ 24 is found in index no. 6.

(2.b) Bubble Sort 17, 51, 9, 39, 1, 6

K=1

a) (17), (51), 9, 39, 1, 6

b) 17, (51), (9), 39, 1, 6

=> 17, 9, (51), (39), 1, 6

c) 17, 9, (51), (39), 1, 6

=> 17, 9, 39, 51, 1, 6

d) 17, 9, 39, (51), (1), 6

=> 17, 9, 39, 1, 51, 6

e) 17, 9, 39, 1, (51), 6

=> 17, 9, 39, 1, 6, [51]

K=2

a) (17), (9), 39, 1, 6, [51]

=> 9, 17, 39, 1, 6, [51]

b) 9, (17), (39), 1, 6, [51]

c) 9, 17, (39), (1), 6, [51]

=> 9, 17, 1, 39, 6, [51]

d) 9, 17, 1, (39), (6), [51]

=> 9, 17, 1, 6, [39, 51]

K=3

a) (9), (17), 1, 6, [39, 51]

b) 9, (17), (1), 6, [39, 51]

=> 9, 1, 17, 6, [39, 51]

c) 9, 1, (17), (6), [39, 51]

=> 9, 1, 6, [17, 39, 51]

K=4

a) (9), (1), 6, [17, 39, 51]

=> 1, 9, 6, [17, 39, 51]

b) 1, (9), (6), [17, 39, 51]

=> 1, 6, [9, 17, 39, 51]

K=5

a) (1), (6), [9, 17, 39, 51]

=> [1, 6, 9, 17, 39, 51]

(3) PUSH : A, B, C, D, E
POP
PUSH : F, G, H, I
POP

Stack: A stack is a list of elements in which an element may be inserted or deleted only at one end. But it must be done on the top of the stack.
→ Push: To insert an element into a stack.
→ POP: To delete an element from a stack.

a) PUSH : A
T = 0 + 1 = 1

b) PUSH : B
T = 1 + 1 = 2

c) PUSH : C
T = 2 + 1 = 3

d) PUSH : D
T = 3 + 1 = 4

e) PUSH : E
T = 4 + 1 = 5

f) POP : ITEM
T = 5 - 1 = 4

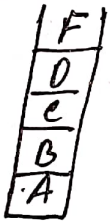
g) PUSH : F
T = 4 + 1 = 5

h) PUSH : G
T = 5 + 1 = 6

i) PUSH : H
T = 6 + 1 = 7
MAX STACK = 6
∴ STACK Overflow.

j) PUSH : I
STACK is already MAX.

k) POP : ITEM
T = 6 - 1 = 5



④ (12/(7-3)+2*(1+5))

Symbol scanned	stack	Expression P
(	(	
12	(	12
/	(/	12
(	(/(	12
7	(/(	12,7
-	(/(-	12,7
3	(/(-	12,7,3
)	(/	12,7,3,-
+	(+	12,7,3,-/
2	(+	12,7,3,-/,2
*	(+*	12,7,3,-,/,2
(	(+*(	12,7,3,-,/,2
1	(+*(	12,7,3,-,/,2
+	(+*(+	12,7,3,-,/,2
5	(+*(+	12,7,3,-,/,2
)	(+*	12,7,3,-,/,2,+
)		12,7,3,-,/,2,+,*,+