

## CSN-102: Data Structures

### Tutorial 3

The Questions marked with a double asterisk (\*\*) can be solved in the next tutorial.

1. Given a string containing opening and closing parentheses, write an algorithm using a stack to check whether the string is balanced or not.

For eg:-  $\{ \{ \} \} \{ \}$  is balanced while  $\{ \{ \} \{ \}$  is not.

2. Write an algorithm using a stack to convert infix expression to postfix expression.

Infix  $\rightarrow (A+B)*C-D$

Postfix  $\rightarrow AB+C*D-$

3. Write an algorithm using a stack to convert infix expression to prefix expression.

Infix  $\rightarrow (A+B)*C-D$

Prefix  $\rightarrow -*+ABCD$

4. Given a postfix expression, write an algorithm involving stack to evaluate it.

For eg:-  $123*+4-$  should evaluate to 3.

5. Given a prefix expression, write an algorithm involving stack to evaluate it.

For eg:-  $+1*23$  should evaluate to 7.

6. Given a string containing lower case Latin letters. Write an algorithm using a stack to check whether the given string is palindrome or not.

A palindrome is a word that reads the same backwards as forwards, eg. Malayalam.

7. Given an array, write an algorithm involving stacks to print the Next Greater Element for every element. The Next greater Element for an element  $x$  is the first greater element on the right side of  $x$  in the array. Elements for which no greater element exist, consider next greater element as -1. Also, discuss the time and space complexity.

For eg:- Array -  $[1,8,7,5,8]$

1  $\rightarrow$  8

8  $\rightarrow$  -1

7  $\rightarrow$  8

5  $\rightarrow$  8

8  $\rightarrow$  -1

8. Given an array and 'q' queries, for each query we are given index 'i'. We need to find the index of the next greater element for that particular 'i'. If there is no such greater element to its right then print -1.

For eg:- Array -  $[1,8,7,5,8]$  (Array Index starts with 1).

Query - 1 -> 2

2 -> -1

5 -> -1

3 -> 5

9. \*\*Write an algorithm to implement Bubble Sort using recursion.
10. \*\*Given coordinates of a source point (x1, y1). Write an algorithm using recursion to determine if it is possible to reach the destination point (x2, y2). From any point (x, y) there only two types of valid movements (x, x + y) and (x + y, y).
11. \*\*Write an algorithm to reverse a stack using recursion.
12. Given a function  $F(n) = (1) + (2*3) + (4*5*6) \dots$  up to n terms. Write an algorithm to find the value of the functions using recursion. You will be given "n" as the input.  
For eg:- (n=4)  $F(4) = (1) + (2*3) + (4*5*6) + (7*8*9*10) = 5167$
13. In a party of N people, only one person (celebrity) is known to everyone and he/she doesn't know everyone at the party. We can only ask questions like "Does A know B?" and receive "Yes" or "No" as the answer. Write an algorithm to find the celebrity by asking a minimum number of questions.
14. Describe how you could use a single array to implement two stacks. tt
15. Describe how you could use a single array to implement three stacks.
16. \*\*Using Master's Theorem find the complexity of the below recurrences:
  - a.  $T(n) = 2T(\sqrt{n}) + (\log n)$
  - b.  $T(n) = T(n/2) + n(2 - \cos n)$
  - c.  $T(n) = T(n/2) + T(n/4) + n^2$
  - d.  $T(n) = 3T(n/3) + n (\log n)$
17. Write an algorithm that prints all possible orderings of the characters in a string. In other words, print all permutations that use all the characters from the original string. For example, given the string "hat", your function should print the strings "tha", "aht", "tah", "ath", "hta", and "hat". Treat each character in the input string as a distinct character, even if it is repeated. Given the string "aaa", your algorithm should print "aaa" six times. You may print the permutations in any order you choose.
18. How to design a stack such that GetMinimum( ) should be  $O(1)$ ?