Recursion
(Assignment Questions)

Question 1 : Write a recursive function to perform **Binary Search.**

Input : arr[ ] = {1, 2, 3, 4, 5, 6, 7}, n = 7, key = 5
Output : 4 (index of key)

*Use the starting index & ending index logic used in rotated, sorted array Qs.

Question 2 : For a given integer array of size N. You have to find all the occurrences (indices) of a given element (Key) and print them.
Use a recursive function to solve this problem.

Sample Input : arr[ ] = {3, 2, 4, 5, 6, 2, 7, 2, 2}, key = 2
Sample Output : 1 5 7 8

Question 3 : We are given a string S, we need to find the count of all contiguous substrings starting and ending with the same character. [Leetcode Premium Qs]

Sample Input 1 : S = "abcab"
Sample Output 1 : 7
There are 15 substrings of "abcab" : a, ab, abc, abca, abcab, b, bc, bca, bcab, c, ca, cab, a, ab, b
Out of the above substrings, there are 7 substrings : a, abca, b, bcab, c, a and b. So, only 7 contiguous substrings start and end with the same character.

Sample Input 2 : S = "aba"Sample
Output 2 : 4
The substrings are a, b, a and aba

Question 4 : TOWER OF HANOI (<mark>Important</mark>!)

You have 3 towers and N disks of different sizes which can slide onto any tower. The puzzle starts with disks sorted in ascending order of size from top to bottom (i.e., each disk sits on top of an even larger one).

You have the following constraints:

(1) Only one disk can be moved at a time.
(2) A disk is slid off the top of one tower onto another tower.
(3) A disk cannot be placed on top of a smaller disk. Write a program to move the disks from the first tower to the
last using Stacks.

Let rod 1 = 'A', rod 2 = 'B', rod 3 = 'C'.
An example with 2 disks i.e. N=2:
Step 1 : Shift the first disk from 'A' to 'B'.

Step 2 : Shift the second disk from 'A' to 'C'.

Step 3 : Shift the first disk from 'B' to 'C'.

An example with 3 disks i.e. N=3 :
Step 1 : Shift the first disk from 'A' to 'C'.
Step 2 : Shift second disk from 'A' to 'B'.
Step 3 : Shift the first disk from 'C' to 'B'.

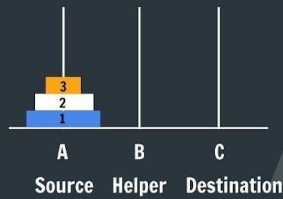Step 4 : Shift the third disk from 'A' to 'C'.

Step 5 : Shift the first disk from 'B' to 'A'.
Step 6 : Shift second disk from 'B' to 'C'.
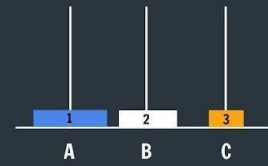Step 7 : Shift the first disk from 'A' to 'C'.

Tower of Hanoi — Visualization for n=3
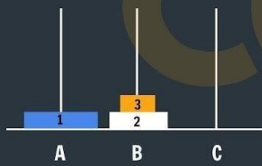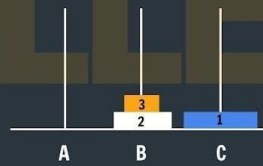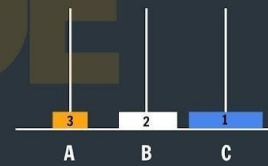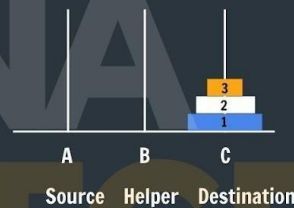

Tower of Hanoi — Visualization for n=3

The Approach here is :
- Shift 'n-1' disks from 'A' to 'B', using C.
- Shift the last disk from 'A' to 'C'.
- Shift 'n-1' disks from 'B' to 'C', using A.

Question 5 : A digit string is good if the digits (0-indexed) at even indices are even and the digits at odd indices are prime (2, 3, 5, or 7).

For example, "2582" is good because the digits (2 and 8) at even positions are even and the digits (5 and 2) at odd positions are prime. However, "3245" is not good because 3 is at an even index but is not even.

Given an integer n, return the total number of good digit strings of length n. Since the answer may be large, return it modulo 109 + 7.

A digit string is a string consisting of digits 0 through 9 that may contain leading zeros.
[Go to Question]

Input: n = 1
Output: 5
Explanation: The good numbers of length 1 are "0", "2", "4", "6", "8".

Hint : This Qs uses the binary exponentiation technique we learnt in the Bit Manipulation chapter.