Agenda

- Recursive Runtimes Practice (also check Master's Theorem)
- Factorial Runtime (Permutations Example)
- Palindrome
- Power a^b Methods
- Count Digits in a Number
- Counts Digits in all Numbers from 1 to N
- Check if a number is Prime
- Sieve of Eratosthenes

Recursive Runtimes Practice:

Steps for recursive tree method for solving recurrences:

- Step-1: Draw a recursive tree
- Step-2: Calculate the work done by each node assuming the recursive calls to be O(1) (say, it is **C**)
- Step-3: Calculate the maximum level of nodes in the recursive tree (say, it is **H**)
- Step-4: Sum up the work done at all the levels in the recursive tree using the previous three steps.

Remember the GP Sum formula -> (a*(r^n - 1)) / (r - 1)
Where,

a = first term of the GP.
r = multiplying factor of the GP.
n = number of terms in the GP.

Example-1:

```
void fun(int n, bool b) {
    …
    return fun(n/2, true) + fun(n/2, false);
}
```

Example-2: F(n) = F(n/2) + F(n/4) + c

```
void fun(int n) {
    …
    return fun(n/2) + fun(n/4);
}
```

Special Palindrome

Given a string, check if it is a special palindrome.
A string is a palindrome if it remains the same when reversed.
But we define a special palindrome as:
A phrase is a palindrome if, after converting all uppercase letters into lowercase letters and removing all non-alphanumeric characters, it reads the same forward and backward.

Input: “level”
Output: true

Input: “levels”
Output: false

Input: “race a car”
Output: false
Explanation: “raceacar” is not a palindrome

Input: “A man: nama”
Output: true
Explanation: “amannama” is a palindrome

Follow-up: Check if a given integer is a palindrome.

Input: 123
Output: false

Input: 1234321
Output: true

Power a^b

Given two numbers a and b, find a^b(a power b).
Assume a >= 1 and b >= 0

Input: a = 2, b = 3
Output: 8

Input: a = 5, b = 2
Output: 25

Input: a = 7653, b = 0
Output: 1

Count Digits in a Number

Given a number, count its number of digits.

Input: 1234313
Output: 7

Input: 0
Output: 1

Counts Digits in all Numbers from 1 to N

Given a number n, find the sum of the number of digits in all numbers from 1 to n.

Input: 10
Output: 11
Explanation:
All numbers from 1 to 10: [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
Number of digits in these:[1, 1, 1, 1, 1, 1, 1, 1, 1, 2]

Input: 25
Output: 41

Solution:
N = 1500
Single digit numbers = 9
Two digit numbers = 99 - 9 = 90
Three digit numbers = 999 - 99 = 900
Four digit numbers = 1500 - 999 = 501

9 + (2*90) + (3 * 900) + (4 * 501)

TODO-1: Find the sum of all digits in a given number.
TODO-2: FInd the sum of digits in all the numbers from 1 to N.

Check if a number is Prime

Given a number n, check if it is a prime number.
(Any number n which is divisible by **only** 1 and n is a prime number).

Input: 0
Output: false

Input: 1
Output: false

Input: 17
Output: true

Input: 20
Output: false

Sieve of Eratosthenes

Given a number n, find all the prime numbers less than or equal to n.

Input: 10
Output: [2, 3, 5, 7]

Input: 20
Output: [2, 3, 5, 7, 11, 13, 17, 19]