Objective:

- Learn to calculate the Time/Space equation.
- To get your hands dirty: It's good for you ☺.

Task-1

Write the Time Equation for the following code snippets.

_____A

```
sum=0;
for(i=0; i<n; i++)
{
    for(j=0; j<n*n; j++)
    {
        sum++;
    }
}
```

_____B

```
sum=0;
for(i=1; i<n; i*=2)
{
    for(j=1; j<n; j++)
    {
        sum++;
    }
}
```

_____C

```
sum=0;
for(i=0; i<n; i++)
{
    for(j=0; j<i*i; j++)
    {
        for(k=0; k<j; k++)
        {
            sum++
        }
    }
}
```

_____D

```
sum=0;
for(i=1; i<n; i++)
{
    for(j=1; j<i*i; j++)
    {
        if (j%i ==0)
        {
            for(k=0; k<j; k++)
            {
                sum++
            }
        }
    }
}
```

Task-2

The running time of a program is $2N^3 + 5N + 3$, where N is the problem size. What are the upper and lower bounds of the growth rate of the program?

Task-3

Programs A and B are analyzed and found to have worst-case running times no greater than $150\log_2 N$ and N^2, respectively. Answer the following questions, if possible:

A. Which program has the better guarantee on the running time, for large values of N (N>10,000)?
B. Which program has the better guarantee on the running time, for small values of N (N<100)?
C. Which program will run faster on average for N=1000?

Is it possible that program B will run faster than program A on all possible inputs?

Task-4

Study the maximum subsequence sum problem given in R3-reference book (Mark Allen Weiss) in section 2.4.3.

You may come across the programming competition problems in which you may crack the problem using maximum subsequence sum problem.

Task-5

Write an efficient Time bound function to find the first non-repeated character in a string. For instance, the first non-repeated character in "total" is 'o' and the first non-repeated character in "PeerPan" is 'r'. Discuss the efficiency of your algorithm.

NOTE: the character in the string will only be English alphabets.

Note: *Dear Students, if you want to take part in programming competitions or just want to challenge yourself by taking up some mind boggling problems: You can ping me to take as much as you can digest.*