



**Exercise: 03**

**Analysis of Algorithms**

**14 – Sep- 2023**

**Observation (5 Marks)**

1. Write down the time and space complexity for the following code

(a) 

```
int a = 0, b = 0;
for (i = 0; i < N; i++)
{
    a = a + rand();
}
for (j = 0; j < M; j++)
{
    b = b + rand();
}
```

(b) 

```
int a = 0;
for (i = 0; i < N; i++)
{
    for (j = N; j > i; j--)
    {
        a = a + i + j;
    }
}
```

(c) 

```
int i, j, k = 0;
for (i = n / 2; i <= n; i++)
{
    for (j = 2; j <= n; j = j * 2)

    {
        k = k + n / 2;
    }
}
```

(d) 

```
int a = 0, i = N;
while (i > 0)
{
    a += i; i /= 2;
}
```

(e) What is the time and space complexity of fun()?

```
int fun(int n)
{
    int count=0;
    for(int i=n;i>0;i/=2)
        for(int j=0;j<i;j++)
            count+=1;
    return count;
}
```

(f) for (i=1; i<=n\*n; i++)  
for (j=0; j<i;j++)  
sum++;

2. Solve the following recurrence relation by mater's theorem

a.  $T(n) = 2T(n/2) + cn$

b.  $T(n) = 2T(n/2) + \sqrt{n}$

3. Write the recurrence relation for the following algorithm and solve

(a) long power(long x, long n)  
if (n == 0) return 1;  
else return x \* power(x, n-1);

(b) long power(long x, long n)  
if (n==0) return 1;  
if (n==1) return x;  
if ((n % 2) == 0) return power(x\*x, n/2);  
else return power(x\*x, n/2) \* x;

(c) long power(long x, long n)  
if (n==0) return 1; if (n==1) return x;  
if ((n % 2) == 0) return power(power(x,n/2), 2);  
else return power(power(x,n/2), 2) \* x;

4. Which case of the Master Theorem applies for the following recurrence realtions?

a.  $T(n) = 4T(n/2)+n$

b.  $T(n) = 4T(n/2)+n^2$

c.  $T(n) = 4T(n/2)+n^3$

5. For the functions,  $nk$  and  $cn$  what is the asymptotic relationship between these functions?

Assume that  $k \geq 1$  and  $c > 1$  are constants.

Execution (15 Marks)

- 6. Write a C program for the following and find the time and space complexity.
  - a. Reverse a string using recursion and iteration
  - b. Copy one string to another using recursion
  - c. Search an element in an array using recursion
  - d. To implement binary search using recursion

7. Write a program to print following :

<b>i)</b>	<b>*****ii)*</b>	<b>iii)</b>	<b>*</b>
	<b>***** **</b>		<b>**</b>
	<b>***** ***</b>		<b>***</b>
	<b>***** ****</b>		<b>****</b>
	<b>*****</b>		<b>*****</b>

<b>iv)</b>	<b>*</b>	<b>v)</b>	<b>1</b>	<b>vi)</b>	<b>1</b>
	<b>***</b>		<b>222</b>		<b>212</b>
	<b>*****</b>		<b>33333</b>		<b>32123</b>
	<b>*****</b>		<b>4444444</b>		<b>4321234</b>
	<b>*****</b>		<b>55555555</b>		<b>543212345</b>
	<b>*****</b>				

- 8. Write a program to calculate the sum of following series where n is input by user. Write the recurrence relation and find the time complexity.  
 $1 + 1/2 + 1/3 + 1/4 + 1/5 + \dots + 1/n$