

Design Analysis and Algorithm – Lab Work

Week 1

Question 1: Write a program to find sum of first n natural numbers using user defined function.

Code:

```
/*write a program to find sum of first n natural numbers using user defined function.*/
#include<stdio.h>
void sum(int n){
    int val=0;
    for(int i=1;i<=n;i++){
        val+=i;
    }
    printf("The value of %d natural numbers is: %d\n",n,val);
}
int main(){
    int n;
    printf("Enter the number to calculate sum of natural numbers:\n");
    scanf("%d",&n);
    sum(n);
    return 0;
}
```

Output:

```
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> gcc Q1.c
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> ./a
Enter the number to calculate sum of natural numbers:
5
The value of 5 natural numbers is: 15
```

Space Complexity:

The space occupied will be 12 bytes. 4 bytes for the value stored in variable **n** and the other for variable **val** & **i** So a total of $4*3=12$ bytes. Therefore, the **Space Complexity will be O (1)**.

Question 2: Write a program to find sum of squares of the first n natural numbers.

Code:

```
/*write a program to find sum of squares of the first n natural numbers.*/
#include<stdio.h>
int main(){
    int n;
    printf("Enter the number to calculate sum of squares of the numbers:\n");
    scanf("%d",&n);
    int val=0;
    for(int i=1;i<=n;i++){
        val+=i*i;
    }
    printf("The sum of square of number till %d is: %d\n",n,val);
    return 0;
}
```

Output:

```
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> gcc Q2.c
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> ./a
Enter the number to calculate sum of squares of the numbers:
5
The sum of square of number till 5 is: 55
```

Space Complexity:

The total space occupied will be 12 bytes. In specific for the variables **n**, **val** and **i** so $3 \times 4(\text{bytes}) = 12$ bytes. Therefore, the **Space Complexity** is **O (1)**.

Question 3: Write a program to find sum of cubes of the first n natural numbers.

Code:

```
/*write a program to find sum of cubes of the first n natural numbers.*/
#include<stdio.h>
int main() {
    int n;
    printf("Enter the number to calculate sum of cubes of the numbers:\n");
    scanf("%d",&n);
    int val=0;
    for(int i=1;i<=n;i++){
        val+=i*i*i;
    }
    printf("The sum of cube of number till %d is: %d\n",n,val);
    return 0;
}
```

Output:

```
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> gcc Q3.c
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> ./a
Enter the number to calculate sum of cubes of the numbers:
5
The sum of cube of number till 5 is: 225
```

Space Complexity:

The total space occupied will be 12 bytes. In specific for the variables **n**, **val** and **i** so $3*4(\text{bytes})=12$ bytes. Therefore, the **Space Complexity is O (1)**.

Question 4: Write a program to find the factorial of a given integer using recursion.

Code:

```
/*write a program to find the factorial of a given integer using
recursion.*/
#include<stdio.h>
int factorial(int n){
    if(n==1){
        return 1;
    }
    else{
        return n*factorial(n-1);
    }
}
int main(){
    int n;
    printf("Enter the number to calculate its factorial\n");
    scanf("%d",&n);
    int fact=factorial(n);
    printf("The factorial of given number is: %d\n",fact);
    return 0;
}
```

Output:

```
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> gcc Q4.c
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> ./a
Enter the number to calculate its factorial
5
The factorial of given number is: 120
```

Space Complexity:

The space totally occupied is $8+4*n$. The initial 8 bytes is for the variables **n** and **fact** in main function and for the **recursive call** $4*n$ bytes. Therefore the **Space Complexity is $O(n)$** .

Question 5: Write a program for transposing a 3 x 3 matrix.

Code:

```
/*write a program for transposing a 3 x 3 matrix.*/
#include<stdio.h>
int main(){
    int a[3][3];
    int t[3][3];
    printf("Enter a 3 x 3 matrix to transpose:\n");
    for(int i=0;i<3;i++){
        for(int j=0;j<3;j++){
            scanf("%d",&a[i][j]);
            t[j][i]=a[i][j];
        }
    }
    printf("Transpose Matrix:\n");
    for(int i=0;i<3;i++){
        for(int j=0;j<3;j++){
            printf("%d\t",t[i][j]);
        }
        printf("\n");
    }
    return 0;
}
```

Output:

```
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> gcc Q5.c
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> ./a
Enter a 3 x 3 matrix to transpose:
1 2 3
4 5 6
7 8 9
Transpose Matrix:
1    4    7
2    5    8
3    6    9
```

Space Complexity:

The space for this program will be 72. Since there are **2 matrices** defined with **3 x 3** so while we are adding elements to both of the matrix will require **$2 \times n^2 \times (4 \text{ bytes})$** of space according to the formula when the matrix has a size of $n \times n$ here since it is 3×3 then the value will be $2 \times 3^2 \times 4 = 72$. Therefore, the **Space Complexity is $O(1)$** .

Question 6: Write a program to calculate Fibonacci of a number.

Code:

```
/*Write a program to calculate Fibonacci of a number*/
#include<stdio.h>

void fibonacci(int n){
    int a=0;
    int b=1;
    int c=0;
    if(n<1){
        printf("Invalid Input.\n");
    }
    else{
        for(int i=1;i<=n;i++){
            if(i>2){
                c=a+b;
                a=b;
                b=c;
                printf("%d\t",c);
            }
            else if(i==1){
                printf("%d\t",a);
            }
            else if(i==2){
                printf("%d\t",b);
            }
        }
    }
}

int main(){
    int n;
    printf("Enter the number to print its Fibonacci.\n");
    scanf("%d",&n );
    fibonacci(n);
    printf("\n");
    return 0;
}
```

Output:

```
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> gcc Q6.c
PS C:\Users\rohit_ytwyq5k\OneDrive - Amrita Vishwa Vidyapeetham- Chennai Campus\4th Semester\Design Analysis And Algorithm> ./a
Enter the number to print its Fibonacci.
5
0      1      1      2      3
```

Space Complexity:

The total space occupied will be 20 bytes. In specific for the variables **n,a,b,c** and **i** so $5 \times 4(\text{bytes}) = 20 \text{ bytes}$. Therefore, the **Space Complexity is O(1)**.