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:

```c
#include <stdio.h>
int sumofNnatnum(int x){
  int sum = 0;
  for (int i = 1 ; i<=x ; i++){
    sum+=i;
  }
  return sum;
}
void main(){
  int x;
  printf("Enter the number: ");
  scanf("%d",&x);
  int k = sumofNnatnum(x);
  printf("Sum of the first %d natural numbers is %d\n",x,k);
}
```

Output:

```
Enter the number: 34
Sum of the first 34 natural numbers is 595
PS C:\Users\kaush\Documents\College\Fourth Sem\DAA>
```

Space Complexity:

```c
/*Space Complexity Calculation
Number of variables = 3
Type of variables = Int
Number of return statements = 1
Total = 3+1
Total Space = 4*4=16bytes
No change in the space w.r.t the input
therefore Space Complexity = O(1)*/
```

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

Code:

```c
#include <stdio.h>
void main(){
  int x;
  printf("Enter the number: ");
  scanf("%d",&x);
  int sum = 0;
  for (int i = 1 ; i<=x ; i++){
    sum+=(i*i);
  }
  printf("Sum of the squares of first %d natural numbers is %d\n",x,sum);
}
```

Output:

```
Enter the number: 23
Sum of the squares of first 23 natural numbers is 4324
PS C:\Users\kaush\Documents\College\Fourth Sem\DAA>
```

Space Complexity:

```c
/*
Space complexity calculation :
space of integer = 4 bytes
number of integer variables = 2
=> 2*4 = 8 bytes
Total space = 8 bytes throughout
Space Complexity = O(1)
*/
```

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

Code:

```c
#include <stdio.h>
void main(){
  int x;
  printf("Enter the number: ");
  scanf("%d",&x);
  int sum = 0;
  for (int i = 1 ; i<=x ; i++){
    sum+=(i*i*i);
  }
  printf("Sum of the squares of first %d natural numbers is %d\n",x,sum);
}
```

Output:

```
Enter the number: 23
Sum of the squares of first 23 natural numbers is 76176
PS C:\Users\kaush\Documents\College\Fourth Sem\DAA>
```

Space Complexity:

```c
/*
Space complexity calculation :
space of integer = 4 bytes
number of integer variables = 2
=> 2*4 = 8 bytes
Total space = 8 bytes throughout
Space Complexity = O(1)
*/
```

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

Code:

```c
#include <stdio.h>
int factorial(int N){
  if (N<=1){
    return N;
  }
  else{
    return (N*factorial(N-1));
  }
}
void main(){
  int x;
  printf("Enter the number: ");
  scanf("%d",&x);
  int k = factorial(x);
  printf("Factorial of %d is: %d\n",x , k);
}
```

Output:

```
Enter the number: 6
Factorial of 6 is: 720
PS C:\Users\kaush\Documents\College\Fourth Sem\DAA>
```

Space Complexity:

```c
/*Space Complexity Calculation
Number of variables = 2
Type of variables = Int
Number of return statements = 2
Total = 2+2
Total Space = 16+4*N Bytes
Change in the space w.r.t the input
therefore Space Complexity = O(N)*/
```

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

Code:

```c
#include <stdio.h>
void main(){
  int matrix[3][3] = {{12,13,41},{15,78,54},{23,76,31}};
  for(int i = 0 ; i<3; i++){
    for (int j = 0 ; j<3; j++){
      matrix[i][j] = matrix[j][i];
    }
  }
  for(int i = 0 ; i< 3; i++){
    for (int j = 0 ; j< 3; j++){
      printf("%d ",matrix[i][j]);
    }
    printf("\n");
  }

}
```

Output:

```
12 15 23
15 78 76
23 76 31
PS C:\Users\kaush\Documents\College\Fourth Sem\DAA>
```

Space Complexity:

```c
/*Space Complexity Calculation
Number of variables = 0
Type of variables = Int
Number of return statements = 0
Space for 2D Array = m*n*4
Total = 36 Bytes
No change in the space w.r.t the input
therefore Space Complexity = O(1)*/
```

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

Code:

```c
#include <stdio.h>
void main(){
  int x;
  printf("Enter the number of terms: ");
  scanf("%d",&x);
  int a=0 , b=1 , c=0;
  for (int i=0 ; i<=x; i++){
    printf("%d",a);
    c=a+b;
    a=b;
    b=c;
  }
}
```

Output:

```
Enter the number of terms: 7
011235813
PS C:\Users\kaush\Documents\College\Fourth Sem\DAA>
```

Space Complexity:

```c
/*Space Complexity Calculation
Number of variables = 4
Type of variables = Int
Number of return statements = 0
Total = 16 Bytes
No change in the space w.r.t the input
therefore Space Complexity = O(1)*/
```