

## Design Analysis and Algorithm – Lab Work

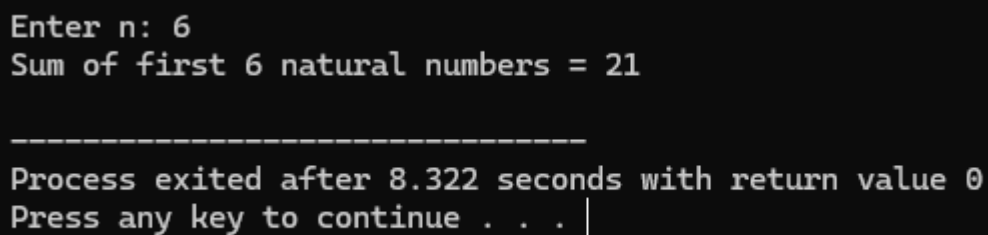
### Week 1

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

**Code:**

```
#include <stdio.h>
int sum(int n) {
    int s = 0;
    for(int i = 1; i <= n; i++) {
        s += i;
    }
    return s;
}
int main() {
    int n;
    printf("Enter n: ");
    scanf("%d", &n);
    int result = sum(n);
    printf("Sum of first %d natural numbers = %d\n", n, result);
    return 0;
}
```

**Output:**

A screenshot of a terminal window showing the output of the program. The text is as follows:  
Enter n: 6  
Sum of first 6 natural numbers = 21  
-----  
Process exited after 8.322 seconds with return value 0  
Press any key to continue . . . |

**Space Complexity:**

The program uses only a few integers n, i, s

**The space complexity is O(1)**

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

**Code:**

```
#include <stdio.h>

int main() {

    int n, sum = 0;

    printf("Enter n: ");

    scanf("%d", &n);

    for(int i = 1; i <= n; i++) {

        sum += i * i;

    }

    printf("Sum of squares of first %d natural numbers = %d\n", n, sum);

    return 0;

}
```

**Output:**

```
Enter n: 5
Sum of squares of first 5 natural numbers = 55

-----
Process exited after 8.059 seconds with return value 0
Press any key to continue . . . |
```

**Space Complexity:**

The memory used does not change with the value of n.

**Space Complexity:  $O(1)$**

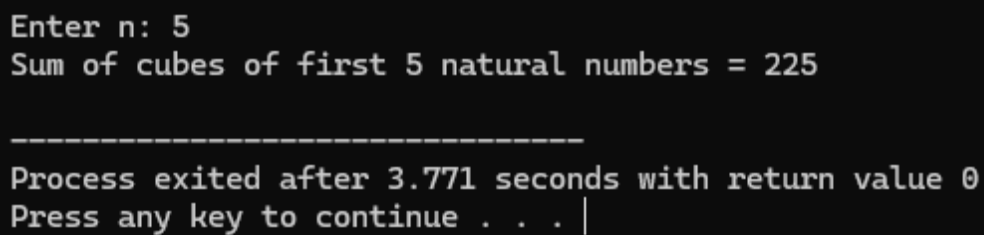
**Question 3: Write a program to find sum of cubes of the first n natural numbers.**

**Code:**

```
#include <stdio.h>

int main() {
    int n, sum = 0;
    printf("Enter n: ");
    scanf("%d", &n);
    for(int i = 1; i <= n; i++) {
        sum += i * i * i;
    }
    printf("Sum of cubes of first %d natural numbers = %d\n", n, sum);
    return 0;
}
```

**Output:**

A screenshot of a terminal window with a black background and white text. The output shows the program's execution: it prompts for 'n' and receives '5', then calculates and displays the sum of cubes of the first 5 natural numbers as 225. Below this, it shows a separator line and then the process exit message: 'Process exited after 3.771 seconds with return value 0' and 'Press any key to continue . . . |' with a cursor.

```
Enter n: 5
Sum of cubes of first 5 natural numbers = 225

-----
Process exited after 3.771 seconds with return value 0
Press any key to continue . . . |
```

**Space Complexity:**

The program uses only a few integer

**Space Complexity:  $O(1)$**

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

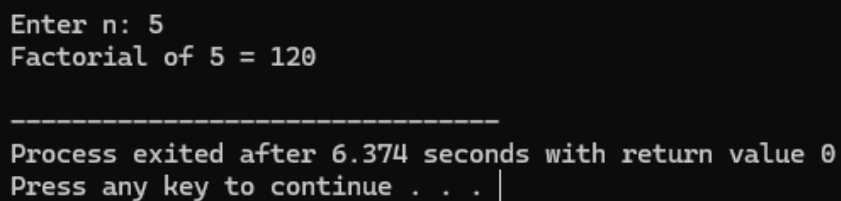
**Code:**

```
#include <stdio.h>

int factorial(int n) {
    if(n == 0)
        return 1;
    else
        return n * factorial(n - 1);
}

int main() {
    int n;
    printf("Enter n: ");
    scanf("%d", &n);
    int result = factorial(n);
    printf("Factorial of %d = %d\n", n, result);
    return 0;
}
```

**Output:**

A screenshot of a terminal window showing the output of the factorial program. The text is as follows:

```
Enter n: 5
Factorial of 5 = 120

-----
Process exited after 6.374 seconds with return value 0
Press any key to continue . . . |
```

**Space Complexity:**

For an input of n the function calls itself n times, so the program repeats n times.

**Space Complexity:  $O(n)$**

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

**Code:**

```
#include <stdio.h>

int main() {
    int a[3][3], t[3][3], i, j;
    printf("Enter elements of 3x3 matrix:\n");
    for(i=0;i<3;i++){
        for(j=0;j<3;j++){
            scanf("%d",&a[i][j]);
        }
        for(i=0;i<3;i++){
            for(j=0;j<3;j++){
                t[j][i]=a[i][j];
            }
        }
        printf("Transpose of the matrix:\n");
        for(i=0;i<3;i++){
            for(j=0;j<3;j++){
                printf("%d ",t[i][j]);
            }
            printf("\n");
        }
        return 0;
    }
```

**Output:**

```
Enter elements of 3x3 matrix:
7
4
1
8
5
2
9
6
3
Transpose of the matrix:
7 8 9
4 5 6
1 2 3

-----
Process exited after 13.02 seconds with return value 0
Press any key to continue . . . |
```

### Space Complexity:

The program uses only two 3x3 matrices with fixed size

Space Complexity:  $O(1)$

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

#### Code:

```
#include <stdio.h>

int fibonacci(int n){
    if(n==0) return 0;
    if(n==1) return 1;
    return fibonacci(n-1)+fibonacci(n-2);
}

int main(){
    int n;

    printf("Enter n: ");
    scanf("%d",&n);
    printf("Fibonacci of %d = %d\n",n,fibonacci(n));
    return 0;
}
```

#### Output:

```
Enter n: 5
Fibonacci of 5 = 5

-----
Process exited after 4.389 seconds with return value 0
Press any key to continue . . . |
```

**Space Complexity:**

Since this program uses recursion and each recursive call is stored on the stack

Space Complexity:  $O(n)$