Design Analysis and Algorithm – Lab Work

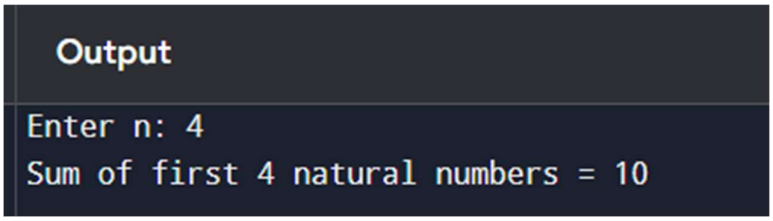
Week 1

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:



Space Complexity:

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

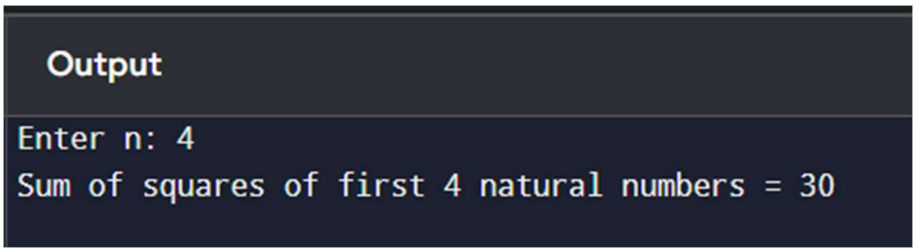
The space complexity is O(1)

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:



Space Complexity:

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

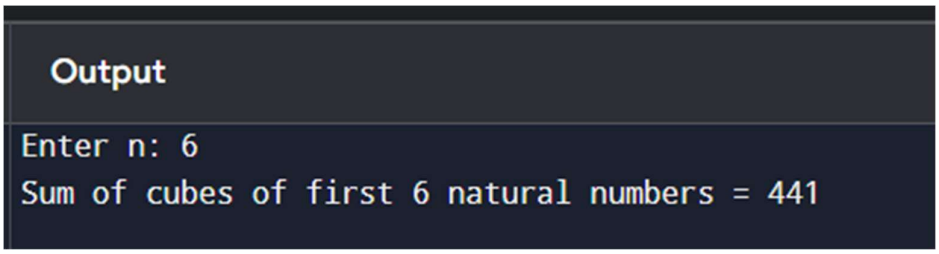
Space Complexity: O(1)

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:



Space Complexity:

The program uses only a few integer

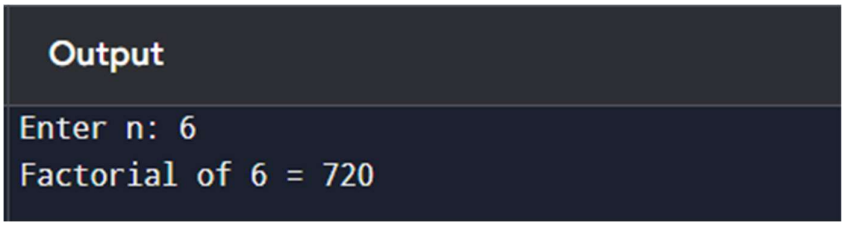
Space Complexity: O(1)

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:



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:

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

Space Complexity:

The program uses only two 3x3 matrices with fixed size

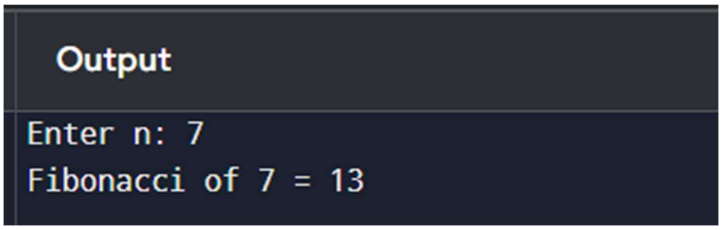
Space Complexity: O(1)

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:



Space Complexity:

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

Space Complexity: O(n)