SCHOOL OF COMPUTING

DESIGN AND ANALYSIS OF ALGORITHMS

LAB WORKBOOK

WEEK - 1

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CLASS : CSE-B

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

CODE:

```c
//Q1. Write a program to find the sum of first n natural numbers using user defined functions.
#include <stdio.h>
int sum(int n){
  int sum=0;
  for (int i = n; i>0; i--){
    sum+=i;
  }
  return sum;
}
int main(){
  int n,sum1;
  printf("Enter the number of numbers: ");
  scanf("%d", &n);
  sum1 = sum(n);
  printf("The sum of first %d natural numbers is %d\n", n, sum1);
  return 0;
}
```

OUTPUT:

```
D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>gcc Q1.C

D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>a
Enter the number of numbers: 4
The sum of first 4 natural numbers is 10
```

Space Complexity: O(1)

Justification:

In main()

int n → 4 bytes
int sum1 → 4 bytes
Total in main() = 8 bytes

In sum()

int sum → 4 bytes
int i → 4 bytes
Total in sum() = 8 bytes

Now the total bytes required for this program is 16 bytes, which is constant.

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

CODE:

```c
//Q2. Write a program to find the sum of squares of first n natural numbers.
#include <stdio.h>
int main(){
```

```c
  int n;
  int sum=0;
  printf("Enter the number of numbers: ");
  scanf("%d", &n);
  for(int i =n;i>0;i--){
    sum+=i*i;
  }
  printf("The sum of squares of first %d natural numbers is %d\n", n, sum);
  return 0;
}
```

OUTPUT:

```
D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>gcc Q2.C

D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>a
Enter the number of numbers: 4
The sum of squares of first 4 natural numbers is 30
```

Space Complexity: O(1)

Justification:

In main()

int n → 4 bytes

int sum → 4 bytes

int i (loop variable) → 4 bytes

Total space in main = 12 bytes

Now. the total space required for the program to execute is always 12 bytes, which is a constant.

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

CODE:

```c
//Q3. Write a program to find the sum of cubes of first n natural numbers.
#include <stdio.h>
int main(){
  int n;
  int sum=0;
  printf("Enter the number of numbers: ");
  scanf("%d", &n);
  for(int i =n;i>0;i--){
    sum+=i*i*i;
  }
  printf("The sum of cubes of first %d natural numbers is %d\n", n, sum);
  return 0;
}
```

OUTPUT:

```
D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>gcc Q3.C

D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>a
Enter the number of numbers: 4
The sum of cubes of first 4 natural numbers is 100
```

Space Complexity: O(1)

Justification:

In main()

int n → 4 bytes
int sum → 4 bytes

int i (loop variable) → 4 bytes

Total space used in main() = 12 bytes

Now. the total space required for the program to execute is always 12 bytes, which is a constant.

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

CODE:

```c
//Q4. 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, fact;
  printf("Enter a number to find the factorial: ");
  scanf("%d", &n);
  fact = factorial(n);
  printf("The factorial of %d is %d\n",n, fact);
  return 0;
}
```

OUTPUT:

```
D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>gcc Q4.C

D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>a
Enter a number to find the factorial: 4
The factorial of 4 is 24
```

Space Complexity: O(n)

Justification:

In main()

int n → 4 bytes
int fact → 4 bytes
Space in main = **8 bytes** (constant)

In factorial()

Each call to factorial(n) creates:

int n → 4 bytes
This function is recursive, so for input **n**, the function calls **n** times.
Space required for the factorial function is 4 * n bytes.

The equation for the Space Complexity is 4*n +8. The order of Space Complexity is **n**.

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

CODE:

```c
//Q5. Write a program for transposing a 3 X 3 matrix.
#include <stdio.h>
int main(){
  int R,C;
  int arr[3][3];
  printf("Enter the elements of the matrices: ");
  for(int i=0;i<3;i++){
    for(int j=0;j<3;j++){
      scanf("%d",&arr[i][j]);
    }
  }
  printf("The transpose of the given matrix is:");
  for(int i=0;i<3;i++){
    printf("\n");
    for(int j=0;j<3;j++){
      printf("%d\t",arr[j][i]);
    }
    printf("\n");
  }
  return 0;
}
```

OUTPUT:

```
D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>gcc Q5.C

D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>a
Enter the elements of the matrices: 1 2 3 4 5 6 7 8 9
The transpose of the given matrix is:
1       4       7

2       5       8

3       6       9
```

Space Complexity: O(1)

Justification:

In main()I
int R → 4 bytes
int C → 4 bytes
Loop variables i and j → 4 + 4 = 8 bytes
int arr[3][3]
9 integers × 4 bytes = 36 bytes.

So total space used in the function is 4+4+8+36 = 52 bytes, which is a constant.

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

CODE:

```c
//Q6. Write a program to find fibonacci series.
#include <stdio.h>
int main(){
  int n,i;
  int a=0, b=1, c;
  printf("Enter the number of Fibonacci Numbers: ");
  scanf("%d" , &n);
  if(n<=0){
    printf("Please enter a positive integer");
    return 0;
  }
  printf("Fibonacci Series: ");
  for (i=1; i<=n;i++){
    if (i==1){
      printf("%d ", a);
      continue;
    }
    if (i==2){
      printf("%d ",b);
      continue;
    }
    c = a+b;
    printf("%d ", c);
    a=b;
    b=c;
  }
  printf("\n");
  return 0;
}
```

OUTPUT:

```
D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>gcc Q6.C

D:\AVV CHENNAI\Semester 4\Design and Analysis of Algorithms\Lab Activities\Week 1>a
Enter the number of Fibonacci Numbers: 8
Fibonacci Series: 0 1 1 2 3 5 8 13
```

Space Complexity: O(1)

In main()

int n → 4 bytes
int i → 4 bytes
int a → 4 bytes
int b → 4 bytes
int c → 4 bytes

So the total space used is 20 bytes, which is a constant.