Apex College

BCIS Program

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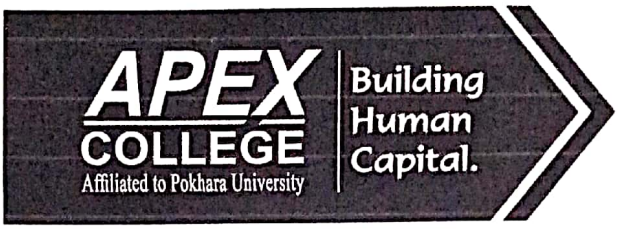

Data Structure & Algorithms
Lab Report

4. Implementation of Recursion on Factorial, Fibonacci & Tower of Hanoi

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#Lab4 Objectives

- To understand recursion
- To implement recursive functions
- To find out factorial, fibonacci series and tower of hanoi problem using recursive function.

#Introduction

- Recursion is a way of defining problem on its own term. It is a method of solving a computational problem where the solution depends on solutions to smaller instances of same problem.
- It is a Buttom up approach to solve problem.
- Recursive function implicitly uses the stack.
- In recursive function, there must be base condition to find recursive output.
- We can use iterative method to solve all the problems that can be solve using recursive function.
- In recursion, we call function inside function which needs to switch context, so that it results by taking more time.
- It has O(n) time complexity, but we still use recursion because of its simplicity to write algorithm and solve large problems in few steps.

* problems that we can solve using recursion:
  1. Factorial
  2. Fibonnaeli Series
  3. Adding a list of numbers
  4. Sudoku
  5. Tower of Hanoi

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Programs to implement Recursion in Factorial, Fibonacci Sequence and Tower of Hanoi.

* For Factorial

$n! = n * (n-1) * (n-2) * \_\_ * 1! * 0!$

```
#include <stdio.h>

int factorial (int n){
   if (n==0)
      return 1;

   else return n * factorial (n-1);
}
void main(){
   int n;
   printf("Enter value of n: ");
   scanf("%d", &n);
   printf("Factorial of %d is %d. \n", n, factorial(n));
}
```

* For Fibonacci

0, 1, 1, 2, 3, 5, 8, 13, 21, 44, . . . n

```
#include <stdio.h>

int fibonacci (int n){
   if (n==0 || n==1)
      return n;

   else
      return (fibonacci(n-1) + fibonacci (n-2));
}

int main(){
   int n, n=0;
   printf("Enter a number of terms in Fibonacci Sequence. \n");
   scanf("%d", &n);
```

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```
    for(int i=1; i<=n; i++){
        printf("%d it", fibonacci(n));
        n++;
    }
    return 0;
}
```

*For Tower of Hanoi

```
#include<stdio.h>
void toh(int n, char s, char t, char d){
    if(n>0){
        toh(n-1, s, d, t);
        printf("move disk %d form %c to %c.\n", n, s, d);
        toh(n-1, t, s, d);
    }
}
void main(){
    int n;
    printf("Enter the number of disk on source tower: ");
    scanf("%d", &n);
    toh(n, 'S', 'T', 'D');
}
```

#Activities

To understand the concept of recursion, we have practice three different problems;

① Factorial of nth number

1. Get user input at variable 'n'
2. Check, if n is 0, then print & return 1.

Otherwise, return n * factorial (n-1)

3. End

② Fibonacci Series of nth terms

1. Get number of terms in Fibonacci sequence.
2. Start loop to continuous iteration from 1 to n by 1 increment
   i.e. for (int i=0 ; i<=n ; i++){
   printf ("%d \t", fibonacci(m));
   m++;
   }
3. Check if n terms is 0 or 1, then return value of n
4. Otherwise, return (fibonacci(n-1) + fibonacci(n-2));
5. End

③ Tower of Hanoi

1. Check if n = 1 ;
   - move a single disk from source to destination
2. If, n > 1 :
   - Let, temp be remaining pole other than source and destination
   - move a tower of (n-1) disks from source to temp tower
   - move a single disk from source to destination
   - move a tower of (n-1) disk from temp to destination
3. End

Conclusion

In lab 4, I have learned about the implementation of recursion in terms of factorial problem, fibonacci series problem and tower of hanoi solution.

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