**Introduction to Computer Science – 150005**

**Lab Assignment #11**

**Recursion**

1. Below are a number of recursive functions. Determine what each one computes.

int question1A ( int a, int b)

{ // a and b are positive integers

if (a < b) return 0;

return (1 + question1A (a-b,b) );

}

int question1B ( int n)

{ // n is a positive integer

if (n < 10) return n;

int a = n % 10;

int b = question1B ( n / 10);

if ( a > b )

return a;

else

return b;

}

int question1C (int num)

{ // num is a positive integer

if (num == 1) return 1;

return question1C (num -1) + 2 \* num -1 );

}

float question1D ( int a[] , int k)

{ // a is a non-empty array of integers. k is a positive integer less than or equal to the length of the array

float f;

if ( k==1) return a[0];

f = question1D ( a,k-1) \* (k-1);

return ( ( a[k-1] + f) / k);

}

int question1E ( int a , int b )

// a is an integer and b is a non-negative integer

{

if ( b == 0 ) return 0;

if ( b % 2 == 0 ) return question1E( a\*2, b / 2);

return question1E ( a \* 2, b / 2) + a;

}

1. Write a recursive function that prints a triangle of stars. The function receives the size of the triangle as an input parameter and with every recursive call prints out the next line of the triangle. For example, it the function is called with the value 4, it prints:  
   \*  
   \*\*  
   \*\*\*  
   \*\*\*\*
2. Write a recursive function that reads in a sequence of characters and prints them out in reverse order. The input is terminated with a ‘.’
3. Write a recursive function that receives an array of integers and the size of the array as input and returns true if the array is sorted in ascending order. Otherwise it returns false.
4. An arithmetic progression is a sequence of numbers such that the difference of any two successive members is a constant. For example, the sequence 1, 2, 3, 4, ... is an arithmetic progression with common difference 1. Write a recursive function that receives an array of integers and the size of the array as input and returns true if the array is an arithmetic progression and false otherwise.
5. Write a recursive function that receives a number in base 10 and prints it in base 8. The algorithm for any number x is as follows:
   1. If x is 0, the process is finished
   2. Otherwise, the least significant octal digit is x mod 8
   3. Replace x with x / 8
   4. Repeat to step a
6. Write a function that receives an array of integers and the size of the array as input (size is initially odd) and prints the values of a in the following order:

a[0],  a[n-1],  a[1],  a[n-2],  ...,  a[(n-1)/2]

1. 8 Queens Problem. Given a chess board having N×N cells, place N queens on the board in such a way that no queen is attacked by any other queen. A queen is attacked by another queen if they appear on the same row, column, or diagonal.