ACADEMY OF TECHNOLOGY

Lab Assignment (Assignment 14)

Paper name: Data Structure and Algorithm

Code: PCC-CS391 **Semester: 3^{rd}**

Discipline: CSE **Time: 2 Hours**

Date: November 11, 2020

1. Write a c program to calculate ${}^{n}C_{r}$ using recursion. ${}^{n}C_{r}$ is defined as:

$$ {}^{n}C_{r} = \begin{cases} 1 & \text{if } n \leq r \text{ or } r = 0 \\ {}^{n-1}C_{r-1} + {}^{n-1}C_{r} & \text{Otherwise} \end{cases} $$

2. Write a program to calculates the Ackermann function $A(m, n)$, which is defined as follows:

$$ A(m,n) = \begin{cases} n+1 & \text{if } m = 0 \text{ and } n > 0 \\ A(m-1, 1) & \text{if } n = 0 \text{ and } m > 0 \\ A(m-1, A(m, n-1)) & \text{Otherwise} \end{cases} $$

Example

```
A (2, 2) = A (1, A (2, 1) )
         = A (1, A (1, A (2, 0) ) )
         = A (1, A (1, A (1, 1) ) )
         = A (1, A (1, A (0, A (1, 0) ) ) )
         = A (1, A (1, A (0, A (0, 1) ) ) )
         = A (1, A (1, A (0, 2) ) )
         = A (1, A (1, 3) )
         = A (1, A (0, A (1, 2) ) )
         = A (1, A (0, A (0, A (1, 1) ) ) )
         = A (1, A (0, A (0, A (0, A (1, 0)))))
         = A (1, A (0, A (0, A (0, A (0, 1)))))
         = A (1, A (0, A (0, A (0, 2) ) ) )
         = A (1, A (0, A (0, 3) ) )
         = A (1, A (0, 4) )
         = A (1, 5)
         = A (0, A (1, 4) )
         = A (0, A (0, A (1, 3) ) )
         = A (0, A (0, A (0, A (1, 2) ) ) )
         = A (0, A (0, A (0, A (0, A (1, 1) ) ) ) )
         = A (0, A(0, A(0, A(0, A(0, A(1, 0))))))
         = A (0, A(0, A(0, A(0, A(0, A(0, 1))))))
         = A (0, A (0, A (0, A (0, A (0, 2) ) ) ) )
         = A (0, A (0, A (0, A (0, 3) ) ) )
         = A (0, A (0, A (0, 4) ) )
         = A (0, A (0, 5) )
         = A (0, 6)
         = 7
```

3. Write a program to check whether two positive integers are relative prime:

$$Prime(x,y) = \begin{cases} true & \text{if } x = 1 \text{ or } y = 1 \\ false & \text{if } x \neq 1,\ y \neq 1 \text{ and } x = y \\ Prime(x, y-x) & \text{if } x \neq 1,\ y \neq 1 \text{ and } x < y \\ Prime(x-y, y) & \text{if } x \neq 1,\ y \neq 1 \text{ and } x > y \end{cases}$$

4. The following algorithm may be used to search an item in a sorted array. Write a program to check whether this algorithm works properly or not.

Algorithm 1: SEARCH $(arr[], left, right, x)$

```
// arr[] is an sorted array, left (Intially left = 0) and right
   (Intially right = n − 1, n is the number of elements) are two
   indices, x is the item which is to be searched
1  if left ≤ right then
2  |  mid1 := left + ⌊(right−left)/3⌋;
3  |  mid2 := right − ⌊(right−left)/3⌋;
4  |  if arr[mid1] = x then return mid1;
5  |  if arr[mid2] = x then return mid2;
6  |  if x < arr[mid1] then return SEARCH(arr, left, mid1 − 1, x);
7  |  else if x > arr[mid2] then return SEARCH(arr, mid2 + 1, right, x);
8  |  else return SEARCH(arr, mid1 + 1, mid2 − 1, x);
9  end
10 return −1;
```