COMP 2080 - Data Structures and Algorithms

Tutorial/Lab 3

Recursion

Learning Objectives:

1. Get familiar basic principles of recursion
2. Discuss and implement the idea of memoization –a technique that uses memory space to improve speed of execution by storing previously calculated values.
3. Apply recursion to solve simple problems.

Implement each of the following recursively defined items

For each you must identify:

a) The base case(s)
b) Code the recursive step.

1. Triangular Numbers

- Triangle(1) =1
- Triangle (n) = n + Triangle(n-1)

2. Factorial:

- 0 factorial =1
- 1 factorial =1
- n!= n * (n-1)!

3. Fibonacci Series

- Fib(0)=0
- Fib(1) =1
- Fib (n)= fib(n-1) + fib(n-2)

4. Create a recursive function printStars(int n) that prints a triangle of stars of size n.

For example if n=4

```
* * * *

* * *

* *

*
```

Should be printed

General Recursive Thinking

5 Write a recursive function gcd that accepts two integers n and m and returns the greatest common divisor of the two integers n and m.

6 Consider a network of streets laid out in a rectangular (Cartesian) grid. When walking east the horizontal distance from one intersection to the next is one unit and when walking north the vertical distance from one intersection to the next is also one unit. A northeast path from one intersection A to another intersection point B is a path taken such that one is allowed to walk in the directions north and east only. Write a recursive function numPaths to count the number of northeast paths from one intersection point (a,b) to another point (x,y) in this network. You may assume x,y is north east of a,b.

7 Write an efficient recursive function that given two positive integers x and n returns the value of xn.

8 An array of size n contains integers in ascending order. Write a recursive function recBinSearch that accepts an integer array list, n and an integer key and returns -1 if the integer key is not in the array and the location in the array if it is present in the array list.

The function mystery below accepts y as an integer greater than or equal to 0;

```
int mystery (int x, int y){

   if (y = = 1)

         return x;

    return x + mystery (x,y-1);

}
```

What is returned by the call mystery(4,2) of the following recursive function? What does the function do? You must clearly show how you arrived at your answer.