COMP 352

Tutorial Session 2

Session Outline

- Quick Overview on Recursion:
  - Definition
  - Recursion Types
- Exercises:
  - Complexity Analysis Extra Problems
  - Recursion application exercises
  - Recursion & Complexity Problems

Quick Overview on Recursion - Definition

- Recursion occurs when a certain function calls itself in its own definition.
- Typically, a recursive function contains:
  - One or more base cases, which are not recursive. These work as a final goal or a stopping point.
  - One or more recursive cases, that solve a small part of the problem and then call the function again to solve the rest

Quick Overview on Recursion - Types of Recursion

- Linear Recursion:
  - Simplest form of recursion
  - Only one recursive call is made per function call
- Tail Recursion:
  - Same as Linear Recursion
  - Recursive call must be the last operation if called

Quick Overview on Recursion - Types of Recursion

Question 1:
Does the following algorithm use tail recursion? *Algorithm* **LinearSum(A, n)**

Input: An integer array *A* and an integer $n \geq 1$, such that *A* has at least *n* elements

Output: The sum of the first *n* integers in *A*

```
if n = 1 then
        return A[0]
else
        return LinearSum(A, n-1) + A[n-1]
```

Quick Overview on Recursion - Types of Recursion

- Binary Recursion:
  - Recursive cases call the function two more times
- Multiple Recursion:
  - Generalization of binary recursion, with multiple recursive calls (more than 2 calls)

Complexity Analysis
Extra Exercises

Question 2:

Consider the following code, n is data size, k is a constant

```
for (i=0; i<n; i=i+k)
        for(j=0; j<i; j++)
                sum[j] = j * sum[i];
```

What is the big-O time complexity in terms of n? Show all necessary steps.

Recursion Exercises

Question 3:

Give a recursive algorithm to compute the product of two positive integers, m and n, using only addition and subtraction.

Recursion Exercises

Question 4:

Describe a recursive algorithm for finding the maximum element in an array A of n elements.

Recursion Exercises

Question 5:

Given an array A of length n containing values in increasing order, write a recursive algorithm to find the first repeated pair of values if such a pair exists.