Homework 5

BASICS OF COMPUTING
(CSCE 101, FALL 2006)
URL: `http://my.unl.edu`

Due on 19th April, 2007

April 5th, 2007

Name :
Course No : **CSCE101**

Instructions:

- **You may neatly print the answers on a printed version of this assignment!**
- If your answers take more than one page, **staple** your homework. Failure to do so may result in portions of the homework being lost. In addition, there will be an automatic 5deduction from the homework grade.
- You must **show all steps of your work for full credit**. Do not simply write final answers for a problem if it involves intermediate steps. In most cases, you will show your work in the same manner that you would for a math class. Writing a short essay describing how you solved the problem is unnecessary.
- The only way to submit your homework is in class at the beginning of the class when it is due.

1. (3 points) Consider a network of 8 computers. How many links would be necessary to create the network using the following organizational structures. Draw a sketch of each topology. *Note: a link is the physical medium (e.g. copper wire) that connects two computers together or one computer to a shared medium.*

   (a) Ring Topology

   (b) Bus Topology (assume that the bus already exists and do not count it as a link).

   (c) Star Topology

2. (3 points) Reference the following URL to answer parts a, b and c of this question. **http://yeti.w3c.org/index.html**

   (a) Identify the document name, protocol, machine name, and domain name in the above URL.

   (b) What is the top-level domain (TLD) in the above URL?

   (c) How can the mnemonic address yeti.w3c.org be converted to its equivalent IP address?

3. (6 points) Does the following program represent an algorithm in the strict sense? Why or why not? Hint: Look at the Formal definition of an algorithm presented in class and in chapter 5.

```
count ← 0
While (Count not 5) do {
    Count  + 2
}
```

4. (10 points) Identify the four Internet software layers, and give a description of each. Be sure to describe each layers job in the communication process, and list some of the protocols used in each layer.

5. (6 points) Describe the steps followed by a machine that wants to transmit a message in a network using the CSMA/CD protocol.

6. (6 points) How does a router differ from such devices as repeaters, bridges, and switches?

7. (10 points) Define an algorithm that finds the largest element in a list of integers, and represent your algorithm using pseudocode. The input to your algorithm will be a list of positive integers (zero is not a positive integer). For example:

   $List_1 = \{2, 5, 9, 22, 13, 5\}$

   $List_2 = \{16, 55, 123, 2, 13, 54, 65, 118\}$

   Notice that the length of the list may vary. You may assume that there exists a function `length(X)` that returns the length of the list X, i.e. `length(`$List_1$`) = 6` and `length(`$List_2$`) = 8`.

   To help you get started here is a skeleton function declaration:

```
FIND_BIG(X) { // X is a list
    //find the largest element in X, and assign it to a variable named bigElem
    return bigElem
}
```

   If we called `FIND_BIG` using $List_1$ and $List_2$ as inputs, `FIND_BIG` should return 22 for $List_1$ and 123 for $List_2$.

   Look at the sequential search algorithm in the slides for inspiration. Also you may find one of the following inequality operators useful ($>$, $<$).

8. (8 points)

   Write a pseudocode function called `SUM_RANGE` that takes as input 2 numbers `low` and `high`, and calculates the sum of all of the numbers from `low` to `high` (including `low` and `high`).

9. (8 points)

   Write a pseudocode function called `AVERAGE` that takes as input 2 numbers, and outputs the average of the two numbers.

10. (15 points) The following is an addition problem in base-10 notation. Each letter represents a different digit. What letter does each digit represent? Explain how you came about the solution.

$$\begin{array}{rr} & \texttt{XYZ} \\ + & \texttt{YWY} \\ \hline & \texttt{ZYZW} \end{array}$$

Hint: Break up the problem by column to obtain several subproblems, i.e.

$$\begin{array}{rr} & C_2 \\ & X \\ + & Y \\ \hline & ZY \end{array} \qquad \begin{array}{rr} & C_1 \\ & Y \\ + & W \\ \hline & C_2 Z \end{array} \qquad \begin{array}{rr} & \\ & Z \\ + & Y \\ \hline & C_1 W \end{array}$$

11. (10 points)

    What sequence of numbers is printed by the following algorithm if it is started with input values 0 and 1?

```
MYSTERY_WRITE(Last, Current) {
    if(Current < 100) then {
        print(Current)
        Temp ← Current + Last
        MYSTERY_WRITE(Current, Temp)
    }
}
```

12. (15 points)

    The factorial of 0 is defined to be 1. The factorial of a positive integer is defined to be the product of that iteger times the factorial of the next smaller nonnegative integer. We use the notation of `n!` to express the factorial of the integer `n`. Thus the factorial of 3 (written 3!) is $3 \times 2! = 3 \times (2 \times 1!) = 3 \times (2 \times (1 \times 0!)) = 3 \times (2 \times (1 \times (1))) = 6$. Design a recursive algorithm that computes the factorial of a given value.