CMPE 300 – Analysis of Algorithms
Fall 2016
Assignment 1

Due: November 11, 17:00

This is an individual homework. Please answer the following questions and submit your answers to your assistant as hard copy. The sole purpose of this homework is to familiarize you with the processes involved in answering complexity related questions. Please work on them by your own. Please do not submit just an answer, but show all your reasoning, and how you arrive at the answers. For any further questions, contact the assistant.

Question 1 (50 points)

SortDesc algorithm takes an array with n elements and sorts the elements in descending order. Assume n is a positive power of 2.
- Write the complexity of this algorithm T(n) as a recurrence relation. **(15 Points)**
- Solve the recursion and find the exact complexity, then state the complexity in big O notation. **(35 Points)**

```
procedure SortDesc(A[0:n-1]) recursive
input:      A[0:n-1]      (an array of integers with size n)
output:     A[0:n-1]      (array altered by procedure)

if n = 2 then
        tempVar ← -1
        if A[0] < A[1] then
                tempVar ← A[0]
                A[0] ← A[1]
                A[1] ← tempVar
        endif
else
        m ← n/2

        for i ← 0 to m-1 do
                Temp1[i] ← A[i]
                Temp2[i] ← A[i+m]
        endfor

        SortDesc(Temp1)
        SortDesc(Temp2)

        i ← 0
        j ← 0
        k ← 0
        while i < m or j < m
                if i = m
```

```
                        Temp3[k] ← Temp2[j]
                        j ← j + 1
                else if j = m
                        Temp3[k] ← Temp1[i]
                        i ← i + 1
                else if Temp1[i] < Temp2[j]
                        Temp3[k] ← Temp2[j]
                        j ← j + 1
                else
                        Temp3[k] ← Temp1[i]
                        i ← i + 1
                endif
                k ← k + 1
        endwhile

        for i ← 0 to m-1 do
                A[i] ← Temp3[i]
        endfor
endif
```

Question 2 (50 Points)

Consider the given function $f(n)$ and determine whether the following cases are true or false. Justify your answers <u>formally</u> ie. show all your work in deriving your answer. (Hint: Use Stirling's Approximation)

$$f(n) = n^4 + n * log(5n! * n^4) + n^2 \sqrt{n} + 42$$

1. $f(n) \in O(n^6)$ **(10 Points)**

2. $f(n) \in o(n^5)$ **(15 Points)**

3. $f(n) \in \Omega(n^3 * log(n))$ **(10 Points)**

4. $f(n) \in \Theta(n^5 * log(n))$ **(15 Points)**