CS3383, Winter 2019 Assignment # 2

Rasoul Shahsavarifar

Faculty of Computer Science, UNB

Due time: Wednesday, Jan/23/2019, 9:20 a.m

Student's full name: ..... Student ID:.....

Note:

- No submission after the due time will be accepted.
- The full credit will be given only for correct solutions that are described clearly.

Question 1: (7 marks) For an inpu with the size of n, consider $Alg1$ to be a recursive algorithm structured as follows:

- For $n = 1$, $Alg1$ requires 3 time units to return an answer.
- For $n > 1$, $Alg1$ recurses 4 times on sub-problems each of size $\frac{n}{4}$.
- To combine the recursion results, $Alg1$ requires $\sqrt{n}$ calculation.

a) write the recurrence $T(n)$ for the running time of $Alg1$

b) Using the recursion tree analysis method, solve $T(n)$ and compute the asymptotic running time of $Alg1$.

Question 2 (8 marks) (From the DPU textbook, Exercise 2.5) Using the Master theorem or recursion tree methods, solve the following recurence relations and give Θ bound for each of them.

a) $T(n) = 9T(n/3) + 3n^2 + 12n - 4$, where $n \geq 1$.

b) $T(n) = T(n-1) + n^c$, where $n \geq 1$ and $c > 0$

c) $T(n) = T(\sqrt{n}) + 1$, where $n > b$ and $T(b) = 2$.

Question 3: (10 marks) Suppose we have a subroutine `merge2` to merge two sorted arrays in **`linear time`** ($\Theta(kn)$). The purpose is to design a divide and conquer algorithm ($Alg2$) to merge k sorted arrays using `merge2` recursively.

a) Write a pseudocode for $Alg2$.
(Hint: Assume that the input is given in a $(k \times n)$ array with the rows and columns sorted in ascending order)

b) Write the running time of $Alg2$ as a recurence relation. $T(k) =?$

c) Construct a recursion tree with $\log k$ levels and $\Theta(kn)$ work per level to represent the recurance relation obtained in part (b).

d) Since k is a constant, is $Alg2$ asymptotically faster than an algorithm with running time $\Theta(n \log n)$? why?