CS3383, Winter 2020 Assignment # 1

Rasoul Shahsavarifar

Faculty of Computer Science, UNB

Due time: Wednesday, Jan/15/2020, 9:30 a.m

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

Note:

- Since the solutions of this assignment will be reviewed in the tutorial on Wednesday (Jan/15 at 9:30 am), 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) Consider the given functions bellow. Sort all of them in increasing order (using the asymptotic order big-O). Provide short explanation for your answer.

- $9 \log n$
- $5 \log \log n$
- $n^{\log^2 n}$
- 3^n
- $n^{n^{\frac{1}{3}}}$
- $(n^n)^{\frac{1}{4}}$
- $(\frac{n}{4})^{\frac{n}{4}}$

Question 2: (3 marks) Among the following given functions, which one(s) is (are) representing the time complexity of a sub-quadratic ($n^{2-\varepsilon}$; $for\ some\ \varepsilon > 0$) algorithm. Explain your answer, and give a polynomial as an example for each part.

- $\Theta(n^{\frac{3}{2}})$
- $n^{\Theta(\frac{3}{2})}$
- $n^{O(\frac{7}{4})}$
- $O(n^{\frac{7}{3}})$

Question 3: (5 marks) (From the DPU textbook, Exercise 1.4) Show that

$$\log(n!) = \Theta(n \log n).$$

(Hint: To show an upper bound, compare $n!$ with n^n. To show a lower bound, compare it with $(n/2)^{n/2}$.)

Question 4: (10 marks) Asymptotically analyze the running time of the following algorithm.

```
Algorithm Intervals(A, n):
Input: array A of n positive integers, indexed from 1, and its size n.
    Y ← 0
    for i from 1 to n
        for j from i to n
            X ← 0
            for k from 1 to j
                X ← X + A[k]
                for h from k to i
                    X ← X · A[h]
            Y ← Y + X
    return Y
```