CSE 551 Homework 1

February 5, 2020

Submission Instructions: Deadline is **11:59pm on 02/13**. Late submissions will be penalized, therefore please ensure that you submit (file upload is completed) before the deadline. Additionally, you can download the submitted file to verify if the file was uploaded correctly. Submit your answers electronically, in a single PDF, via *Canvas*. You can type up the answers or scan (or take pictures) your handwritten answers.
Furthermore, please note that the graders will grade 2 out of the 4 questions randomly. Therefore, if the grader decides to check questions 1 and 4,and you haven't answered question 4, you'll lose points for question 4. Hence, please answer all the questions.

1. Prove of disprove the following with valid arguments:

   (i) $n! \in O(n^n)$.
   (ii) $2n^2 2^n + nlog(n) \in \Theta(n^2 2^n)$.
   (iii) $n^{1.001} + nlog(n) \in \Theta(n^{1.001})$.
   (iv) $10n^2 + 9 = O(n)$.
   (v) $n^2 log(n) = \Theta(n^2)$.
   (vi) $n^3 2^n + 6n^2 3^n = O(n^3 2^n)$.

2. Suppose that you have algorithms with the size running times listed below.Assume that these are the exact number of operations performed as a function of the input size n. Suppose you have a computer that can perform 10^{10} operations per second, and you need to compare a result in at most an hour of computation. For each of the algorithms, what is the largest input size n for which you would be able to get the result within an hour?
   (i) n^2.
   (ii) n^3.
   (iii) $100n^2$.
   (iv) 2^n.

3. Define the Hamiltonian Cycle Problem and the Travelling Salesman Problem. Give a polynomial-time transformation from the Hamiltonian Cycle

Problem to the Travelling Salesman Problem to claim that if the Hamiltonian Cycle is "Hard" (i.e., NP-Complete) then Travelling Salesman Problem must also be hard.

4. Take the following list of functions and arrange them in ascending order of growth rate. That is, if function g(n) immediately follows f(n) in your list, then it should be the case that f(n) is O(g(n)).

   (i) $f_1(n) = n^{3.4}$.
   (ii) $f_2(n) = (2n)^{0.7}$.
   (iii) $f_3(n) = n^3 + 100$.
   (iv) $f_4(n) = 20^n$.
   (v) $f_5(n) = 250^n$