CSE 551
Assignment 1

14^{th} September, 2020

Submission Instructions: Deadline is **11:59pm on 09/21/2020**. 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. **Please TYPE UP YOUR SOLUTIONS and submit a PDF** electronically, via *Canvas*.
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 or disprove the following assertions: **(8+8+9)**

   (i) If $f(n) = O(g(n))$ then $log_2 f(n) = O(log_2 g(n))$
   (ii) If $f(n) = O(g(n))$ then $3^{f(n)} = O(3^{g(n)})$
   (iii) If $f(n) = O(g(n))$ then $f(n)^3 = O(g(n)^3)$

2. Algorithm A_1 takes $10^{-4} \times 2^n$ seconds to solve a problem instance of size n and Algorithm A_2 takes $10^{-2} \times n^3$ seconds to do the same on a particular machine. **(8+8+9)**
   (i) What is the size of the largest problem instance A_2 will be able solve in one year ?
   (ii) What is the size of the largest problem instance A_2 will be able solve in one year on a machine one hundred times as fast ?
   (iii) Which algorithm will produce results faster, in case we are trying to solve problem instances of size less than 20 ?

3. Prove or disprove the following with valid arguments: **(8+8+9)**

   (i) $3n^2 + 1000 = O(n)$.

   (ii) $2n^3 log(n) = \Theta(n^3)$.

   (iii) $3^n n^4 + 8 * 4^n n^3 = O(3^n n^4)$.

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)). **(25)**

   (i) $f_1(n) = n^{4.2}$.
   (ii) $f_2(n) = (2n)^{1.2}$.
   (iii) $f_3(n) = n^{4.1} + 87$.
   (iv) $f_4(n) = 60^n$.
   (v) $f_5(n) = 180^n$