CSC 225 FALL 2018
ALGORITHMS AND DATA STRUCTURES I
ASSIGNMENT 1 - WRITTEN
UNIVERSITY OF VICTORIA

- Submission guidelines:
  - Assignments should be uploaded to Connex->Assignments. You can write your solutions using a text editor and upload the PDF file or you can write it by hand and take a CLEAR photo or scan it, and then upload it.
  - Include your V number and your name as it appears on Connex Roster, otherwise, the TAs may not be able to enter your grades.
  - Due date is Monday October 1st 3:30 pm. Late assignments are not accepted.

1. Order the following list of functions by their big-Oh notation. Group together (for example, by underlining) those functions that are big-Theta of one another. (No proof needed)
   Note: $\log n = \log_2 n$ unless otherwise stated.

$6n \log n$	2^{100}	$\log \log n$	$\log^2 n$	$2^{\log n}$
$2^{(2^n)}$	$\sqrt{n}$	$n^{0.01}$	$1/n$	$4n^{3/2}$
$3n^{0.5}$	$5n$	$2n \log^2 n$	2^n	$n \log_4 n$
4^n	n^3	$n^2 \log n$	$4^{\log n}$	$\sqrt{\log n}$

Hint: When in doubt about two functions $f(n)$ and $g(n)$, consider $\log f(n)$ and $\log g(n)$ or $2^{f(n)}$ and $2^{g(n)}$. Also, CLRS section 3.2 is very useful here.

2. Prove that if $d(n) = O(f(n))$ and $e(n) = O(g(n))$, then the product $d(n)e(n) = O(f(n)g(n))$.

3. Show that $\log_b f(n) = \Theta(\log_2 f(n))$ if $b > 1$ is a constant.

4. Consider the Algorithm ArrayFind, given below, which searches an array A for an element x.
   Input: An element x and an n-element array, $A[0, .., n-1]$. (Indices start from 0.)
   Output: The index i such that $x = A[i]$ or -1 if no element of A is equal to x.

   ArrayFind(A, x)
   1. $i = 0$
   2. **while** $i < n$ **do**
   3. **if** $x == A[i]$
   4. **return** i
   5. **else**
   6. $i = i + 1$
   7. **return** -1

   Counting **assignments**, **comparisons**, and **returns** only, calculate the worst-case and best-case running times of ArrayFind. (Do not use asymptotic notations or parametric constants for this; count the exact number of these three simple operations.)