CSE100 Algorithm Design and Analysis Discussion Chapter 03 Spring 2019
Last update: 2/4/2019

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You're expected to work on the discussion problems before coming to the lab. Discussion session is not meant to be a lecture. TA will guide the discussion and correct your solutions if needed. We will not release 'official' solutions. If you're better prepared for discussion, you will learn more. TAs will record names of the students who actively engage in discussion and report them to the instructor; they are also allowed to give some extra points to those students at their discretion. The instructor will factor in participation in final grade.

1. (Basic) Rank the following functions by order of growth; that is, find an ordering $g_1, g_2, \cdots, g_k$ (here $k$ is the number of functions given) such that $g_1 = O(g_2)$, $g_2 = O(g_3), \cdots, g_{k-1} = O(g_k)$. (For example, if you are given functions, $n^2, n, 2n$, your solution should be either $n, 2n, n^2$ or $2n, n, n^2$. )

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|---|---|---|---|---|---|
| $n^2 + 2^n$ | $n \log n$ | $n^2 \log^2 n$ | $n \log^2 n$ | $n^2$ | $\log^{100} n$ |
| $\log \log n$ | $n^3$ | $1$ | $\log n$ | $\log n / \log \log n$ | $n^2 / \log n$ |
| $n^{10} \cdot 3^n$ | $4^n$ | | | | |

2. (Basic) What is $\lim_{n\to\infty} \frac{n^{10} \cdot 3^n}{4^n}$? Which one is asymptotically no smaller between the two functions?
3. (Basic) Formally prove that $n^2 + 100 = O(n^2)$ using the definition of $O(\cdot)$.
4. (Basic) Formally prove that $n^2 = \Omega(n^2 + 100)$ using the definition of $\Omega(\cdot)$.
5. (Basic) Formally prove that $n^2 = \Omega(n \log_2 n + 100)$ using the definition of $\Omega(\cdot)$.
6. (Basic) Formally prove that $n + 10 = \Theta(50n + 1)$ using the definition of $\Theta(\cdot)$.
7. (Intermediate) Prove that $f = O(g)$ implies $g = \Omega(f)$.
8. (Intermediate) Prove that $f = \Omega(g)$ and $g = \Omega(h)$ implies $f = \Omega(h)$.