

CSCI 3104: Algorithms

Homework 1

Due at **11:00am on Wednesday, September 10, 2014**. Submit your solution in paper before class. Make sure to include your name, student id, and signature indicating adherence to the Honor Code Pledge (<http://honorcode.colorado.edu/about-honor-code>).

1. Algorithms are designed to solve certain computation tasks that are specified by the expected input and output. For each of the following problems, how would you specify its input and output?
 - (a) Driving directions.
 - (b) Course scheduling.
 - (c) Google's web search problem.
 - (d) Amazon's item recommendation problem.
2. In each of the following situations, indicate whether $f = O(g)$, or $f = \Omega(g)$, or both (in which case $f = \Theta(g)$). Briefly explain why.
 - (a) $f(n) = 3n^7 + 4n^3$ $g(n) = 100n^5 + 50n^2 + 100$
 - (b) $f(n) = \log(10n)$ $g(n) = \log(n^3)$
 - (c) $f(n) = 3^n/7$ $g(n) = n^5 \log n$
 - (d) $f(n) = (\frac{3}{2})^n$ $g(n) = 8n^4 + 6 \log n$
3. We introduced in class that when analyzing algorithm complexity, we can ignore the lower-order terms and the coefficient of the leading term. For example, $4n + 8 \Rightarrow n$. Using the formal definition of the big- O notation, show that $4n + 8 = O(n)$ and $n = O(4n + 8)$, in other words, $4n + 8 = \Theta(n)$.
4. Write a python program to sort n integers using the selection sort algorithm introduced in class. For each $n = 10^3, 10^4, 10^5, 10^6$, generate 10 sets of n random integers in the range of $[0, 1000000]$, report the running time (min, max, and average) across the 10 rounds of sorting. Provide your answers along with your source code, and specify the type of machine you used for testing (CPU, memory size, OS).