

Comp 4433 Assignment 1

Each student is required to do this assignment individually and to hand in the answer sheet through D2L on the due date. You may use Microsoft Word or other software to type out your answer. The solutions should be neat and easy to read.

The score of the assignment will depend on:

Specification and documentation: 20 %

Correctness: 80 %

Late assignments will be penalised (-10% with 1-day delay; -20% with 2-day delay and -30% with 3-day delay) and will not be accepted after 3 days.

Problem 1.

Prove that $f(n) = \Theta(g(n))$ if and only if $f(n) = O(g(n))$.

Problem 2.

Let $f(n)$ and $g(n)$ be asymptotically nonnegative functions. Using the definition of Θ -notation, prove that $\max(f(n), g(n)) = \Theta(f(n) + g(n))$.

Problem 3.

Let $f(n)$ and $g(n)$ be asymptotically positive functions. Prove or disprove each of the following conjectures.

- $f(n) = O(g(n))$ implies $g(n) = O(f(n))$.
- $f(n) = O(g(n))$ implies $\log(f(n)) = O(\log(g(n)))$, where $\log(g(n)) > 1$ and $f(n) > 1$ for all sufficiently large n .
- $f(n) + g(n) = \Theta(\min(f(n), g(n)))$.
- $f(n) = O((f(n))^2)$.

Problem 4.

The selection sort is as follows: Consider an array A with n numbers. First we find the smallest element of A and exchange with the element in $A[1]$. Then find the smallest element of $A[2 \dots n]$ and exchange it with the element in $A[2]$. Continue in this manner for the first $n-1$ elements of A .

- Write pseudocode for this algorithm.
- Give the best-case and worst-case running time of select sort in Θ -notation.