Due: 3:30pm October 7th, 2016
Date: September 23, 2016

Assignment 1

Grades : each assignment is 5% in the final score and there is a 2% bonus in each assignment for bonus problems. We use the following scale for the simplicity of grading: the total score is 50 (additional 20 for bonus problems) for each assignment.

Problem 1 [Full Score: 15]. Solve the following problems from the book. For each problem, provide the "big-Oh" characterization of the running time and a brief explanation. You do not need a formal proof.

(1)[5] R-1.11 (on page 48).

(2)[5] R-1.13

(3)[5] R-1.14

Problem 2 [Full Score: 15]. Prove the following properties about the "big-Oh" notation from the textbook. Assume $f(n), g(n), d(n), e(n), h(n)$ are non-negative. Remember to show your choices of c and n_0 for each $O(\cdot)$ statement.

(1)[5] R-1.15 (on page 49).

(2)[5] R-1.16

(3)[5] R-1.25

Problem 3 [Full Score: 20]. As all for loop algorithms, Algorithm 1.2 (p.7) can be written as a while loop. Write such a loop L: while C do B for Algorithm 1.2. Then design a loop invariant I to prove the correctness of the computation which converts the before-loop state $\langle P \rangle$ into the after-loop state $\langle Q \rangle$: P is $(i = 0) \wedge (currentMax = A[0])$ and Q is "currentMax is the maximum value stored in A". Prove the correctness of the while loop by proving the following three conditions: (**follow the examples in the note**)

- $P \rightarrow I$.
- $\langle I \wedge C \rangle \, B \, \langle I \rangle$.
- $\langle I \wedge \neg C \rangle \rightarrow Q$.

Problem 4 [Bonus Problems: 20]. Solve the following problems from the textbooks about $O(\cdot)$ and $\Omega(\cdot)$ notations.

(1)[10] C-1.9 (on page 51)

(2)[10] C-1.11