
CSED332 ASSIGNMENT 4

Due Wednesday, October 13

Problem 1. Consider the following program to find the maximum value in an array. Write a Hoare logic proof (decorated program) to prove the given Hoare triple.

```
1 {0 < N}
2 int m = A[0];
3 int i = 1;
4 while (i < N) {
5     if (A[i] > m)
6         m = A[i];
7     else
8         skip;
9     i = i + 1;
10 }
11 {m = max(A[0], A[1], ..., A[N - 1])}
```

Problem 2. Write a Hoare logic proof (decorated program) to show that the given Hoare triple holds and the program always terminates (*hint*: what is a ranking function?).

```
1 {x ≥ 0 ∧ y > 0}
2 int r = x;
3 int q = 0;
4 while (y ≤ r) {
5     r = r - y;
6     q = q + 1;
7 }
8 {x = qy + r ∧ 0 ≤ r < y}
```

Problem 3. Consider the following program for sorting an array. Write a Hoare logic proof to prove the given Hoare triple, where $sorted(a_1, a_2, \dots, a_k)$ means $a_1 \leq a_2 \leq \dots \leq a_k$.

```
1 {0 ≤ N}
2 int i = 1;
3 while (i < N) {
4     int j = i;
5     while (j > 0 && A[j-1] > A[j]) {
6         int t = A[j-1];
7         A[j-1] = A[j];
8         A[j] = t;
9         j = j - 1;
10    }
11    i = i + 1;
12 }
13 {sorted(A[0], A[1], A[2], ..., A[N - 1])}
```

Turning in

- Create a private project with name **homework4** in <https://csed332.postech.ac.kr>. Upload a scanned copy (or a typewritten document) of your answers in *PDF format* to **homework4**.