School of Computing and Information Systems

COMP10002 Foundations of Algorithms

Sample Solution to Sample Mid-Semester Test #1

Question 1 (7 marks).

Watch out for right variable types, initializing sum, correct assignment using the pointer, and manipulating the arrays correctly. But with those exceptions, most of you should get most of the marks, this was a pretty easy (maybe too easy) question the year I used it.

```
#include <math.h>

int
calc_rms(double X[], double Y[], int n, double *rms) {
    int i;
    double sum, diff;
    if (n<=0) {
        return RMS_INVALID;
    }
    sum = 0.0;
    for (i=0; i<n; i++) {
        diff = (X[i] - Y[i]);
        sum += diff*diff;
    }
    *rms = sqrt(sum/n);
    return RMS_VALID;
}
```

Question 2 (3 marks).

You have to have understood the definitions, of course; and also have a mental model of the hierarchy of functions. But once you have those two things, only carelessless will prevent full marks.

(a) $f_1(n) = 2n + 5 \in O(n)$.

(b) $f_2(n) = 2n - \log n + 1 \in O(n)$.

(c) $f_3(n) = 4n - \log n + 6 \in O(n)$.

(d) $f_4(n) = (2n + 5)(2n - \log n + 1) = 4n^2 + \text{smaller terms} \in O(n^2)$.

(e) $f_5(n) = (2n+5) - (2n - \log n + 1) = \log n + 4 \in O(\log n)$. In this particular case, because you are given exact values for $f_1()$ and $f_2()$, you can cancel the leading terms. But in general, if all you know is that $f_1(n) \in O(n)$ and $f_2(n) \in O(n)$, then all you can say is that $f_1(n) - f_2(n) \in O(n)$.

(f) $f_6(n) = \frac{(2n+5)}{(2n - \log n + 1)} = 1 +$ smaller terms $\in O(1)$. Note that you don't have to work out the details of the division at all, that is another reason why we like asymptotic analysis rather than doing exact arithmetic.