

## csc380: Design and Analysis of Algorithms

### Solutions

Homework-1 (*this homework is worth 5% of course grade*)

All answers must be type and uploaded to Blackboard before due date

1. Suppose you have algorithms with the five running times listed below. (Assume these are the exact running times.) How much slower (by what factor) do each of these algorithms get when you double the input size.

- (a)  $n^2$
- (b)  $n^3$
- (c)  $100n^2$
- (d)  $n \log n$
- (e)  $2^n$

#### Answer

(a)  $(2n)^2/n^2 = 4$

(b)  $(2n)^3/n^3 = 8$

(c)  $100(2n)^2/100n^2 = 4$

(d)  $2n \log(2n)/n \log n = 2n(1 + \log n)/n \log n = 2 + 2/\log n$

(e)  $2^{2n}/2^n = 2^n$

2. Take the following list of functions and arrange them in ascending order of growth rate. That is, if function  $g(n)$  immediately follows function  $f(n)$  in your list, then it should be the case that  $f(n)$  is  $O(g(n))$ .

$$f_1(n) = n^{2.5}$$

$$f_2(n) = \sqrt{2n}$$

$$f_3(n) = n + 10$$

$$f_4(n) = 10^n$$

$$f_5(n) = 100^n$$

$$f_6(n) = n \log n$$

#### Answer

$$f_2(n) = \sqrt{2n} = \sqrt{2}n^{0.5}$$

$$f_3(n) = n + 10$$

$$f_6(n) = n \log n$$

$$f_1(n) = n^{2.5}$$

$$f_4(n) = 10^n$$

$$f_5(n) = 100^n$$