

1. Consider the function

$$3n^2 + 10n \lg n + 5n$$

- (a) What is the high order term?
- (b) What is the second order term?
- (c) What is the third order term?
- (d) Write the function in Theta notation (in the simplest way).

2. For each of the following say TRUE or FALSE. No justification needed.

(a)

$$e^{\pi x} = \Theta(\pi^{ex})$$

(b)

$$e^{\pi x} = O(\pi^{ex})$$

(c)

$$e^{\pi x} = o(\pi^{ex})$$

(d)

$$e^{\pi x} = \Omega(\pi^{ex})$$

(e)

$$e^{\pi x} = \omega(\pi^{ex})$$

3. Bubble Sort can be thought of as a recursive algorithm as follows: Bubble the largest element to the bottom of the list (to be sorted). Recursively sort the remaining elements.

- (a) Write down the recursive version of Bubble Sort in psuedocode.
- (b) Derive a recurrence for the exact number of comparisons the algorithm uses.
- (c) Solve the recurrence using the tree method. Simplify as much as possible. NOTE: The tree is very, very narrow.

4. We can multiply two three-digit numbers using nine atomic multiplications and some constant number of atomic additions.

- (a) Using this fact, write a recurrence for an algorithm that recursively multiplies two n -digit numbers. Note that you do not have to describe the algorithm itself. To keep things simple assume that for size n it takes cn time to do the additions for some constant c (after the recursive calls), and that each atomic multiplication takes time μ . You can also assume that n is a power of 3.
- (b) Solve the recurrence using the tree method. Simplify as much as possible.