CS 240 Tutorial 2

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5:20 PM

Review Problem 1:

Is $n^{\left[\left(\tan n \sum_{x=0}^{\infty} \frac{(-1)^x}{(2x)!} n^{2x}\right)^2 + 1\right]} \in O(n^2)$?

Yes.

$$\left(\tan n \sum_{x=0}^{\infty} \frac{(-1)^x}{(2x)!} n^{2x}\right)^2 = \left(\frac{\sin n}{\cos n} \cdot \cos n\right)^2$$

$$= \sin^2 n$$

Yields: $n^{(\sin^2 n + 1)}$ but $1 \leq \sin^2 n + 1 \leq 2$

So:

$n \leq n^{\sin^2 n + 1} \leq n^2$ for $c = 1$ and $n_0 = 1$

Review Problem 2:

What is the runtime of the following algorithm?

```
  for i = 1 to n
A   for j = 1 to n
      if j mod 13 == 0
        j = n
B   for k = 1 to n
      int x = k x i
```

There are two inner loops labeled A and B

A runs exactly 13 times, then exits, $A \in \Theta(1)$
B runs n times, $B \in \Theta(n)$

Then we have:

$$\sum_{i=0}^{n} \left(\Theta(1) + \Theta(n)\right)$$

$$= \underbrace{(\Theta(1)+\Theta(n)) + \ldots + (\Theta(1)+\Theta(n))}_{n \text{ times}}$$

$$= \Theta(n)\left(\Theta(1)+\Theta(n)\right)$$

$$= \Theta(n^2+n)$$

$$= \Theta(n^2)$$

Problem 3:

Given a set S of n integers, where each integer $s_i \in S$ is between 0 and 10^4. S may contain duplicates.

a) Give a $\Theta(n)$ algorithm to sort S. Why is it $\Theta(n)$?

b) Give an algorithm that computes the number of duplicates a particular integer has in S.