Homework 2:
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Task 1:

A) Is $2^{n+1} = O(2^n)$?

Answer: Using the Limit Asymptotic Theorem the $\lim_{x\to\infty} \frac{f(x)}{g(x)} = L$ where

$f(x) = 2^{n+1}$ and $g(x) = 2^n$ we get $\lim_{n\to\infty} \frac{2^{n+1}}{2^n}$ which is equal to $\frac{\infty}{\infty}$ so using algebra we

can get that $\lim_{n\to\infty} \frac{2 * \cancel{2^n}}{\cancel{2^n}} = 2$. According to the Limit Asymptotic Theorem

if $L = C$ where C is a constant, then the $\lim_{n\to\infty}$ is $\Theta(n)$ so, $2^{n+1} = O(2^n)$ but it is mainly $\Theta(2^n)$,

since $\Theta(n)$ means that it is both $O(n)$ and $\Omega(n)$.

B) Is $2^{2n} = O(2^n)$?

Answer: Using the Limit Asymptotic Theorem the $\lim_{x\to\infty} \frac{f(x)}{g(x)} = L$ where

$f(x) = 2^{2n}$ and $g(x) = 2^n$, we get $\lim_{n\to\infty} \frac{2^{2n}}{2^n} = \lim_{n\to\infty} \frac{(2^n)^2}{2^n} = \lim_{n\to\infty} \frac{2^n * \cancel{2^n}}{\cancel{2^n}} = \lim_{n\to\infty} 2^n = \infty$,

meaning that this is $\Omega(2^n)$ which then means that it is not $O(2^n)$.

Task 2: Let $f(n) = (\frac{4}{9})^0 + (\frac{4}{9})^1 + (\frac{4}{9})^2 + \ldots + (\frac{4}{9})^n$. Find Θ for $f(n)$.

Answer: Where $x = \frac{4}{9}$ and $0 < \frac{4}{9} < 1$, so $\sum_{k=0}^{n} x^k \leq \sum_{k=0}^{\infty} x^k = \frac{1}{1-x} = \frac{1}{1-\frac{4}{9}} \rightarrow 1.8$

Meaning that this function is $\Theta(C) = \Theta(1.8) = \Theta(1)$.

Task 3: Do the following tasks to Compile the program.
1. Run the command “make” in terminal.
2. run the ./insertion_sort.e program.
3. Enter the name of the file you wish to sort.
Done!