# Algorithms HW

1.)

1a.) $2^{n+1} \in O(2^n)$, this is true because

$2^{n+1} \leq 5 \cdot 2^n$, we only need a single C that allows $2^n$ to dominate $2^{n+1}$ so its true. Also $\lim_{n \to \infty} \frac{2^{n+1}}{2^n} = 2 \leq C$. So

1b.) $2^{2^n} \in O(2^n)$

$\lim_{n \to \infty} \frac{2^{2^n}}{2^n} = \infty$

$\infty$ cant be bounded by C so this function is not dominated by $2^n$ at any C. Thus the function is not in the set.

1d.) $\lim_{n \to \infty} \frac{\log^2 n}{n^{1.01}} = 0 \leq C$ so $n^{1.01}$ dominates $\log^2 n$. So $\log^2 n$ is a suitable lower bound for $n^{1.01}$ and it is in the set $\Omega(\log^2 n)$

1c.) $\lim_{n \to \infty} \frac{n^{1.01}}{\log^2 n} = \infty$ which cant be bounded by C. This means that $\log_3^2 n$ does not dominate $n^{1.01}$. This means $n^{1.01}$ IS NOT in the set $O(\log^2 n)$

1e.) $\lim_{n \to \infty} \frac{\sqrt{n}}{(\log n)^3} = \infty$ which cant be bounded by C.

1f.) $\lim_{n \to \infty} \frac{(\log n)^3}{\sqrt{n}} = 0$ which means $\sqrt{n}$ dominates $(\log n)^3$. This means that $\sqrt{n}$ can be in the set $\Omega(\log^3 n)$

1g.) if a function f is in the set $o(g(n))$ then $g(n)$ dominates f for every value of C. If function f is in $\omega(g(n))$ then f dominates $g(n)$ for every value of C.

Since $f(n) \leq C \cdot g(n)$ and $g(n) \leq C \cdot f(n)$ cant occur at the same time and there is a contradiction if they are both true the set is empty.

2.)

2b.) gives number of fibonacci sequence at specified place.
For example X=7 gives 13.

3.)

3a.)

3b.) work: O(N)
span: O(N)

3c.) work: O(N)
span: O(N)