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CMPS 2200 Assignment 1

Question 1

(a) $2^{n+1} \in O(2^n)$

$$\lim_{n \to \infty} \frac{2^{n+1}}{2^n} = 2$$

Thus, the answer is yes since c is a constant greatter than or equal to 0.

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

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

No because c is not a constant

(c) $n^{1.01} \in O(\log^2 n)$

$$\lim_{n \to \infty} \frac{n^{1.01}}{\log^2 n} = \infty$$

No because c is not a constant.

(d) $n^{1.01} \in \Omega(\log^2 n)$

$$\lim_{n \to \infty} \frac{\log_2 n}{n^{1.01}} = 1$$

Yes, because $c \geq 0$

(e) $\sqrt{n} \in O(\log n)^3$

$$\lim_{n \to \infty} \frac{(\log n)^3}{\sqrt{n}} = \infty$$

No because $c \neq$ constant

(f) $\sqrt{n} \in \Omega (\log n)^3$

$$\lim_{n \to \infty} \frac{(\log n)^3}{\sqrt{n}} = \infty$$

No b/c $c \neq$ constant

(g) Prove that $o(g(n)) \cap \omega(g(n))$ is an empty set

$$o(g(n)) = \lim_{n \to \infty} \frac{f(n)}{g(n)} = 0$$

$$\omega(g(n)) = \lim_{n \to \infty} \frac{f(n)}{g(n)} = \infty$$

Both of these cannot be true at the same time as $n \to \infty$, so $f(n)$ does not exist. Thus $o(g(n)) \cap \omega(g(n))$ is an empty set.

Question 2

(a) In .md file

(b) This function returns the nth term of the fibonacci sequence by recursively adding n-1 and n-2.

Question3

(a) In .md file

(b) Work = 10

Span = 9

(c) In .md file

(d) Work = 20

Span = 18

(e) Work = 30

Span = 28