Tanner Martz

Assignment #1

1A) Is $2^{n+1} \in O(2^n)$? $\Rightarrow f(n) = 2^{n+1}$, $g(n) = 2^n$

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

the limit is not equal to 0.

thus 2^{n+1} not bounded by 2^n.

1B) Is $2^{2^n} \in O(2^n)$? $\Rightarrow f(n) = 2^{2^n}$, $g(n) = 2^n$

$$\lim_{n\to\infty} \frac{2^{2^n}}{2^n} = \left(\ln(2)\right) \lim_{n\to\infty} \left(2^{2^n}\right)$$

$$(\ln(2))(\infty) = \infty$$

The limit is not equal to 0.

Thus not upperbounded by 2^n.

1C) Is $n^{1.01} \in O(\log^2 n)$? $\Rightarrow f(n) = n^{1.01}$, $g(n) \log_2(n)$

$$\lim_{n\to\infty} \frac{n^{1.01}}{\log_2(n)} = \lim_{n\to\infty} \frac{1.01\, n^{1.01}}{\frac{1}{n \cdot \ln(2)}} = .7n^{1.01}$$

The limit is not equal to 0.

$n^{1.01}$ is not upperbounded by $\log_2(n)$.

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Assignment 1 pt. 2

1D) Is $n^{1.01} \in \Omega(\log^2 n)$? $\Rightarrow \lim_{n\to\infty} \frac{n^{1.01}}{\log_2(n)} > 0$

$n^{1.01}$ is lower bounded by $\log_2(n)$.

1E) Is $\sqrt{n} \in O((\log n)^3)$? $\Rightarrow \lim_{n\to\infty} \frac{\sqrt{n}}{(\log n)^3}$

$\lim_{n\to\infty} \frac{\ln(2)\sqrt{n}}{\log_2(n)^2} = \frac{\ln^{3/2}}{48}$ $\lim_{n\to\infty} \sqrt{n} = \infty$

$\lim_{n\to\infty} \frac{f(n)}{g(n)}$ not equal 0.

$\sqrt{n}$ is not upper bounded by $(\log n)^3$

1F) Is $\sqrt{n} \in \Omega((\log n)^3)$?

$\lim_{n\to\infty} \frac{\sqrt{n}}{(\log)^3}$ is > 0

$\sqrt{n}$ is lower bounded by $(\log n)^3$

2(A): CODE

2(B): What does the function do?

The function for the fibinacci sequence iterats through the list, saving values as it progresses. This is a recursive function. First check x to a valid input, then call the function with values (x-1) and (x-2). Sum these values and return the input. Run the function until complete.

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Assignment 1 pt. 3

3A) CODE

3B) What is the work and span?

$W(n) = 2C_1 + n \times C_2 \in O(n)$ where C_1 = integer ass.

$S(n) = 2C_1 + n \times C_2 \in O(n)$ C_2 = cost per iteration of the loop

3C) CODE

3D) What is the work and span?

C_1 = Thread operation

C_2 = Conditional Check

C_3 = List operation

$$W(n) = \log n \sum_{i=0}^{i} \left(C_3 n + 2^i C_1\right) + C_2$$

$W(n) \in O(n \log n)$ ★ work

$$S(n) = \log n \sum_{i=0} (\log(n) - i) + C_2$$

$S(n) \in O(\lg^2(n))$ ★ span

3E) What is the work and span of parallized algorithm?

C_1 = Thread operation

C_2 = Conditional check

C_3 = List operation

$$W(n) = \sum_{i=0}^{n} (i(3) + C_2$$

$W(n) = \in O(n^2)$

$$S(n) = \sum_{i=0}^{n} (i(3) + C_2$$

$S(n) \in O(n^2)$