Intro to Algorithms, COMP-160, Homework #1

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3. **Let $f(x) = O(x)$ and $g(x) = O(x)$. Let c be a positive constant.**
   Prove or disprove that $f(x) + c \cdot g(y) = O(x + y)$.

   Because $f(x) = O(x)$ and $g(x) = O(x)$, we know $f(x) \leq c_1 \cdot x$ and $g(y) \leq c_2 \cdot y$ for some c_1 and c_2

   $$f(x) + c \cdot g(y) \leq c_1 \cdot x + c \cdot c_2 \cdot y = c_3(x + y)$$

   We can define c_1 and c_2 such that $c_1 = c \cdot c_2 = c_3$, showing the existence of a valid c_3.

   Therefore, $\exists c_n$ such that $f(x) + c \cdot g(y) \leq c_n \cdot (x + y)$, so $f(x) + c \cdot g(y) = O(x + y)$.