Asymptotic Notation

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1 Definitions

Which of the following is the correct English description of $f(n) = O(g(n))$?

- ○ For every constant $c > 0$, there is an n_0, such that for all $n \geq n_0$, we have $f(n) \leq c \cdot g(n)$.
- ● There is some $c > 0$ and some n_0, such that for all $n \geq n_0$ we have $f(n) \leq c \cdot g(n)$.
- ○ For every n_0, there is some constant $c > 0$ such that for all $n \geq n_0$ we have $f(n) \leq c \cdot g(n)$.

Correct

Suppose that $g(n) > 0$ for all integers n. Then is $f(n) = O(g(n))$ equivalent to the following simpler definition that avoids n_0? Note the implicit assumption that $f(n)$ and $g(n)$ are functions over nonnegative integers.

$$\exists c > 0 : \forall n \; f(n) \leq c \cdot g(n)$$

- ● Yes
- ○ No

Correct

Suppose that $f(n) = O(g(n))$. Which of the following is implied by this fact?

- ● $g(n) = \Omega(f(n))$
- ○ $g(n) = O(f(n))$
- ○ Both
- ○ Neither

Correct

If $f(n) = O(g(n))$, is it true that $2^{f(n)} = O\left(2^{g(n)}\right)$?

- ○ Yes
- ● No

Correct

2 Examples

What is the smallest exponent x such that

$$n^2 + n^3 - n = O(n^x)?$$

3

Correct

Which of the following describes $n(n+1)(n+2)/6$?

- ○ $O(n^4)$
- ○ $O(n^3)$
- ○ $\Theta(n^3)$
- ○ $\Omega(n^2)$
- ● All of the above

Correct

For which exponents x is $n(n+1)/2 = \Theta(n^x)$?

- ○ 1
- ● 2
- ○ 3
- ○ All of the above

Correct

For which function $g(n)$ is it true that $n^2 = O(g(n))$?

- ● $g(n) = 1.01^n$
- ○ $g(n) = 2^n \cdot \sin(\pi n/2)$
- ○ $g(n) = 2^n \cdot \cos(\pi n/2)$
- ○ All of the above

Correct