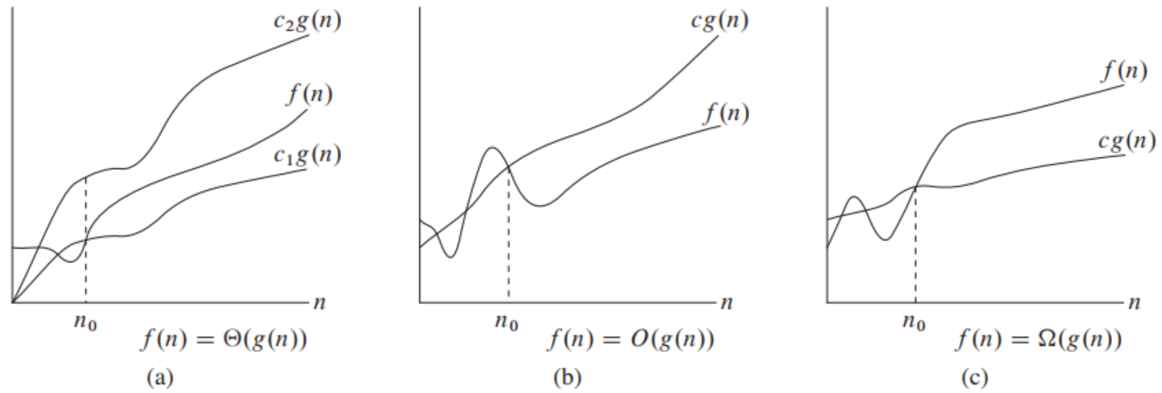
Asymptotic Notation

- **asymptotic notation** is often used to describe the running times of algorithms
- it is a way of abstracting the actual function that describes the running time of an algorithm



Θ-notation *"asymptotically tight bound"*

- $\Theta(g(n))$ denotes the set of functions $f(n)$
- a function $f(n)$ belongs to the set if there exists positive constants c_1, c_2 such that it can be "sandwiched" between $c_1g(n)$ and $c_2g(n)$ for sufficiently large n
    - "sufficiently large n" can be expressed as "for all $n \geq n_0$"
- we often abuse notation and say "a function $f(n)$ = $\Theta(g(n))$" or "... is $\Theta(g(n))$"
    - we mean $\in \Theta(g(n))$
    - but the abuse is useful because if we write something like $2n^2 + \Theta(n)$ it is clear we mean $2n^2 + f(n)$ where $f(n) \in \Theta(n)$

O-notation *"asymptotic upper bound"*

Ω-notation *"asymptotic lower bound"*

"$\Theta = O + \Omega$" Theorem

- for any 2 functions $f(n), g(n)$ we have $f(n) = \Theta(g(n))$ if and only if $f(n) = O(g(n))$ and $f(n) = \Omega(g(n))$