Topics to discuss

① Theta Notation (Θ - notation)

② Examples

Theta Notation

This notation decides whether the upper and lower bounds of a given function (algorithm) are the same. The average running time of an algorithm is always between the lower bound and the upper bound.

It is defined as $\Theta(g(n)) = \{ f(n) :$ there exist positive constants c_1, c_2 and n_0 such that $0 \leq c_1 g(n) \leq f(n) \leq c_2 g(n)$ for all $n \geq n_0 \}$.

$g(n)$ is asymptotic tight bound for $f(n)$.

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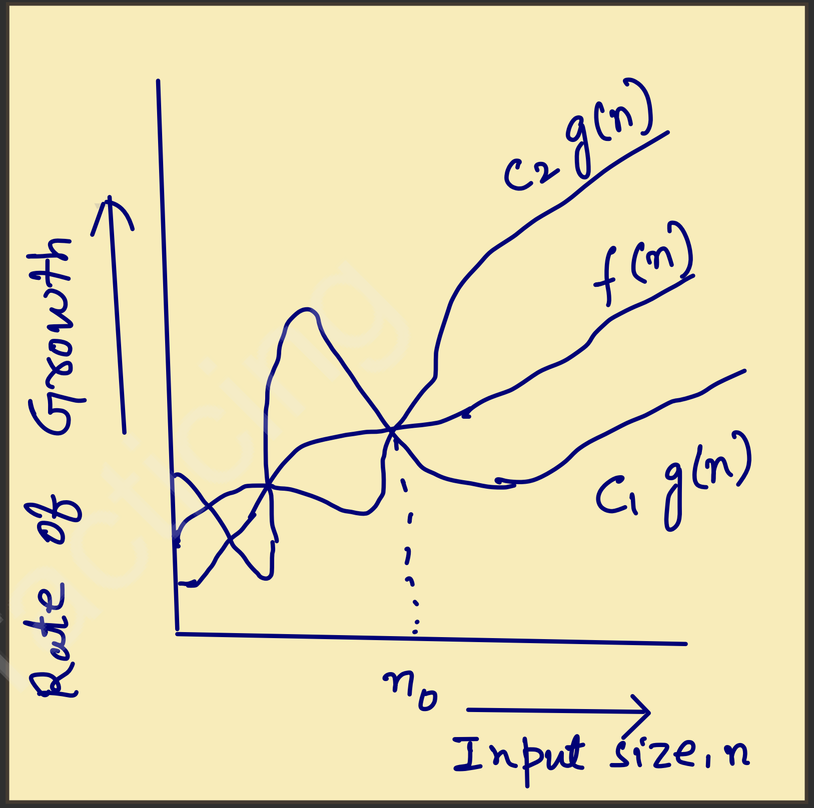
$\Theta(g(n))$ is the set of functions with the same order of growth as $g(n)$.



(1) Find θ bound for $f(n) = \frac{n^2}{2} - \frac{n}{2}$

Solution :- $f(n) = \frac{n^2}{2} - \frac{n}{2}$

By definition, $c_1 \, g(n) \leq f(n) \leq c_2 \, g(n)$

$$\frac{n^2}{5} \leq \frac{n^2}{2} - \frac{n}{2} \leq n^2$$

$c_1 = \frac{1}{5}$, $c_2 = 1$

$g(n) = n^2$

$f(n) = \theta(g(n))$

$f(n) = \theta(n^2)$

② Prove $n \neq \Theta(n^2)$

Solution :-

Given, $f(n) = n$

$g(n) = n^2$

We know,

$$c_1 g(n) \leq f(n) \leq c_2 g(n)$$

$$n^2 \leq n \leq n^2 \quad \boxed{n=1}$$

$\boxed{\text{This is not true.}}$

Hence, $n \neq \Theta(n^2)$ (Proved)

Follow Now

Start Practicing

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