$f(n) \in \Theta(g(n))$

a) $f(n) \in O(g(n))$

b) $g(n) \in O(f(n))$

ξ $f(n) \notin \Omega(g(n))$

$\iff g(n) \notin O(f(n))$

$f(n) \in O(g(n))$, and $g(n) \in O(f(n))$, $\iff f(n) \in \Theta(g(n))$.

Prove that $3n^2 \notin O(n)$

Proof: BWOC. Suppose $3n^2 \in O(n)$

Then $\exists\, c, n_0$ s.t.

$$3n^2 \leq c \cdot n \quad \forall n \geq n_0.$$

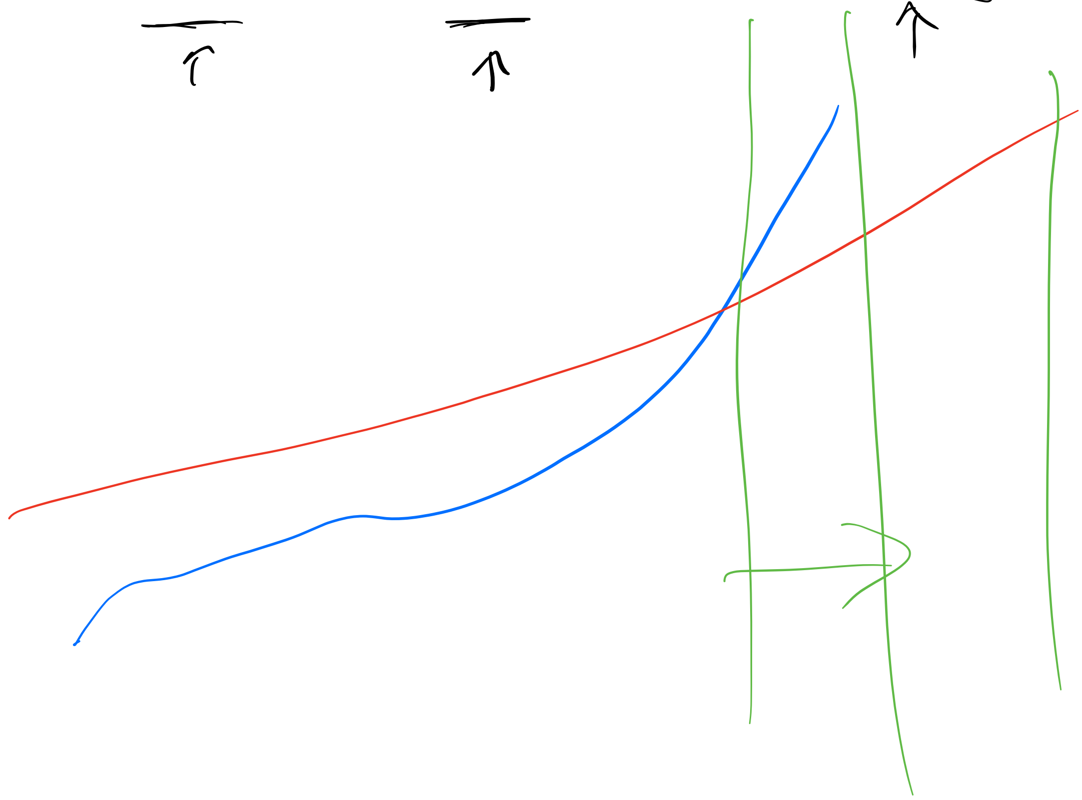
$$n \leq \frac{c}{3} \quad \forall n \geq n_0$$

$$\Rightarrow\Leftarrow$$

$\therefore\ 3n^2 \notin O(n)$

$\lesssim$

$\forall n \geq \boxed{n_0}$



Shuffle($A[1 \ldots n]$)

Shuffle($A[1 \ldots \frac{n}{3}]$) ← 2 calls

Shuffle($A[\frac{2n}{3} \ldots n]$)

Do $\Theta(n)$ work.

$\frac{1}{3}$ the size

Let $T(n)$ be the running time.

$$T(n) = \underset{a}{2}\, T\left(\frac{n}{\underset{b}{3}}\right) + \underbrace{n}_{f(n)} \qquad n^{\log_3 2} \approx .5\,?$$

$$O\left(n^{\log_3 2 - \varepsilon}\right)$$

$$n^1 \overset{?}{\in} \Theta\left(n^{\log_3 2}\right) \qquad \approx n^{.5}$$

$$\Omega\left(n^{\log_3 2 + \varepsilon}\right)$$

$n!$ $\quad 2^n$?

$$\left(\frac{1}{2}\right) \frac{2 \times 3 \times 4 \times \ldots \times (n-2) \times (n-1) \times n}{2 \times 2 \times 2 \times \ldots \times 2 \times 2 \times 2}$$

Def'n Θ, Ω

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$$

$$\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} \ldots = 1$$