Asymptotic Notation

1) worst case scenario ✶
   ↳ Big O ⇐══ ┌─── Problem statement
              Optimize ╱ │ ╲
2) best case scenario ═══ S1 S2 S3
   ↳ Ω

3) Average case Scenario
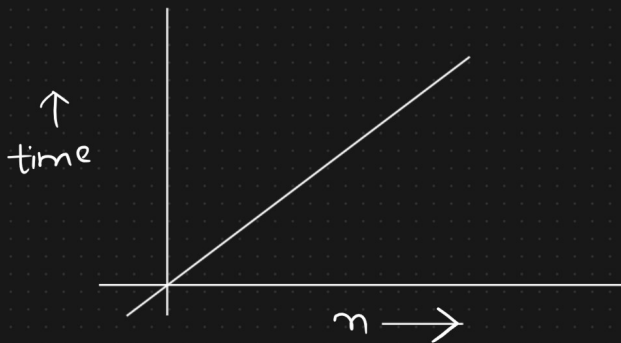   ↳ θ

$n \rightarrow$ size of an array (very large)

Summation $(n = 10) \longrightarrow$ 10 ms
   ↳
              ↓   ↓
           $n = 1000 \longrightarrow$ 100 ms

↑
time

$n \rightarrow$

Graphical Representation

$c \cdot g(n)$

$f(n)$

$n_0 \rightarrow$ Threshold size

Big O Notation **(Main focus)**

$f(n) = O(g(n))$ ✓ $\longleftarrow$ **Mathematical Intuition**

$\underline{f(n) \leq c \cdot g(n)}$

$\forall \left\{ \begin{array}{l} n \geq n_0 \\ c > 0 \\ n_0 \geq 1 \end{array} \right\}$ — constant

$\boxed{f(n) = 5n \\ g(n) = n}$ ——— $f(n) = O(g(n)) \longleftarrow$ **True**

Example 1

$f(n) \leq c \cdot g(n)$

$5n \leq c \cdot n \longleftarrow$

$\boxed{c \geq 5}$

satisfied

Example 2 $f(n) = n$

$g(n) = 5n$

$f(n) = O(g(n)) \longrightarrow$ True

$f(n) <= c \cdot g(n)$

$n <= c \cdot 5n \longleftarrow$ Satisfied

$c = \frac{1}{5} \rightarrow$ constant

Example 3 $f(n) = n^2$ $g(n) = n$ ~~True~~ **false**

$f(n) = O(g(n)) \longrightarrow$ ~~True~~

$f(n) <= c \cdot g(n)$

$n^2 <= c \cdot n \longrightarrow$ True

$c = n \longrightarrow c \propto n$