* Common Asymptotic

Constant	$\Theta(1)$
Logarithmic	$\Theta(\log n)$
linear	$\Theta(n)$
~~nlog~~ nlogn	$\Theta(n \log n)$
Quadratic	$\Theta(n^2)$
Cubic	$\Theta(n^3)$
Polynomial	$n^{\Theta(1)}$
Exponential	$2^{\Theta(1)}$

* Time Complexity Binary Search

$$T(N) = C + T\left(\frac{N}{2}\right) \quad \text{— (1)}$$

$$T\left(\frac{N}{2}\right) = C + T\left(\frac{N}{4}\right) \quad \text{— (2)}$$

As Equation (1) holds for every N. that's why eq. (2) also ~~sta~~ satisfies.

Substitute (2) in (1)

$$T(N) = T\left(\frac{N}{4}\right) + 2C \quad \text{— (3)}$$

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$$T\left(\frac{N}{4}\right) = C + T\left(\frac{N}{8}\right) \quad \text{— (4)}$$

Substitute (4) in (3)

$$T(N) = T\left(\frac{N}{8}\right) + 3C \quad \text{— (5)}$$

Here Pattern

$$\boxed{T(N) = T\left(\frac{N}{2^i}\right) + iC}$$

At some point, as $N/2^i$ diminishes, we have only one element

$$T\left(\frac{N}{2^i}\right) = T(1)$$

$$T(N) = T\left(\frac{N}{2^i}\right) + iC \quad \text{— (6)}$$

$$\frac{N}{2^i} = 1 \implies N = 2^i$$

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Take log on Both Sides

$$\log_2 N = \log_2 2^i$$

$$\log_2 N = i \quad \text{—— } (7)$$

Substitute (7) in (8) equation (6)

$$T(N) = T\left(\frac{N}{2^{\log_2 N}}\right) + c\log_2 N$$

$$= T\left(\frac{N}{N}\right) + c\log_2 N$$

$$T(N) = T(1) + c\log_2 N$$

$$T(N) = k + c\log_2 N$$

$$T(N) = \log_2 N$$

$T(N)$ is $O(\log_2 N)$

Binary Search Worst Case Complexity is Big-oh $(\log_2 N)$

or $O(\log N)$