



## Types of Asymptotic Analysis

And their explanations

\* Asymptotic Analysis is used to describe the running time or (space) of algorithms as the input size  $n \rightarrow \infty$ .

There are types:

### 1. Big O — $O(f(n))$

\* Describes the worst case growth rate.

\* Tells you the maximum time (or space) your algorithm might take.

\* Example:

\* Linear Search  $\rightarrow O(n)$

\* Merge Sort  $\rightarrow O(n \log n)$

### 2. Omega — $\Omega(f(n))$

\* Describes the best-case growth rate.

\* Gives a lower bound — the minimum time (or space) the algorithm will take.

## Example:

Linear Search  $\rightarrow O(1)$  if  
lucky (first element is target)

3. Theta -  $\Theta(f(n))$ :

- \* Describes the tight bound,

- \* Means it grows at this rate both in best and worst case

Example:

- \* For simple addition of  $n$  numbers  
 $\rightarrow O(n)$

4. Little  $o$  -  $o(f(n))$

- \* Means strictly less than  $O(f(n))$ , not tight.

- \* Shows an upper bound that is not  
~~But it is not~~ asymptotically tight.

- \* Informally - grows slower than  $f(n)$ .



5. Little omega —  $\omega(f(n))$

\* Means Strictly more than  $\Omega(f(n))$ ,  
not tight.

\* Shows a lower bound that is  
not asymptotically tight.

\* Informally — grows faster than  $f(n)$ .