

EXPONENTIAL SEARCH

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DEFINITION

Exponential Search is a searching algorithm used to find an element in a sorted array. This algorithm works by increasing the search range exponentially (by doubling the index) and then applying Binary Search within the identified range. Exponential Search is very efficient for large datasets, especially when the target element is located near the beginning of the array.

FORMULA/ TIME COMPLEXITY

Exponential Search combines two processes, resulting in the following complexities:

- Time Complexity
 - Best Case: $O(1)$
 - Average Case: $O(\log n)$
 - Worst Case: $O(\log n)$
- Space Complexity
 - $O(1)$ (iterative implementation)
- The index grows exponentially as:
 $i = 2^k$ (1, 2, 4, 8, 16,....)

HOW DOES EXPONENTIAL SEARCH WORKS?

The algorithm follows these steps:

1. Check the first element If **array[0]** equals the target, the search is complete.
2. Find the search range

-Start with index **i = 1**

-Double the index (**i = i × 2**) while:

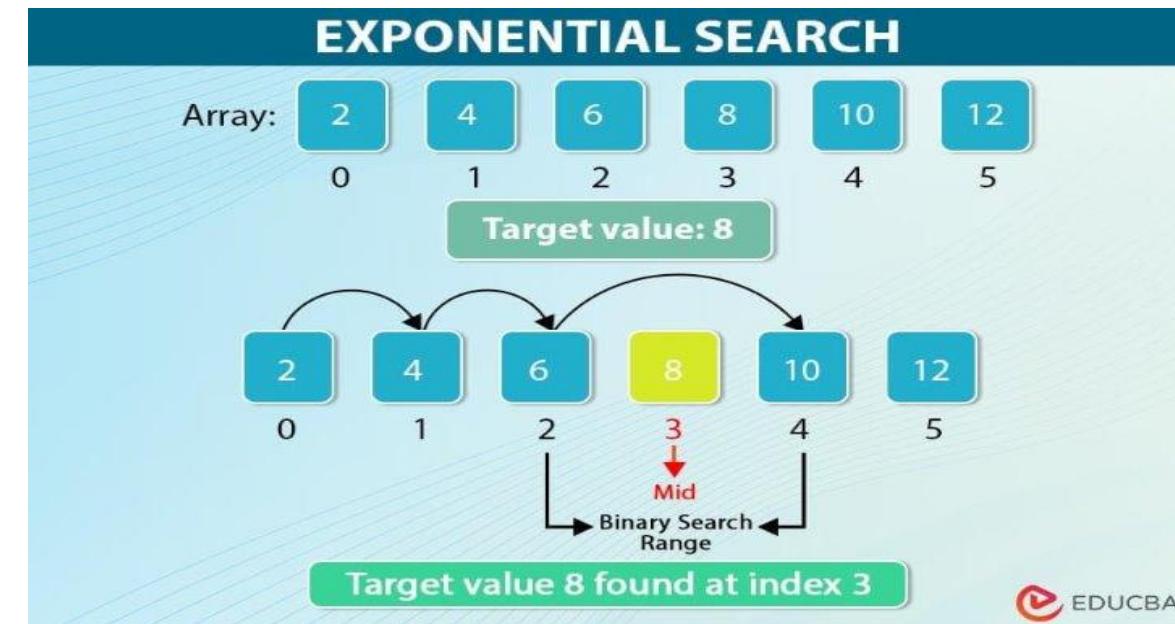
$i < n$, and

$array[i] \leq \text{target}$

3. Apply Binary Search

-Perform Binary Search between:

Low = $i/2$, high = $\min(i, n - 1)$



EXAMPLE

Sorted array:

$A = [2, 4, 6, 8, 10, 12, 14, 16, 18]$

Target = 14

-Step 1: Check the first element $A[0] = 2 \neq 14 \rightarrow$ continue

-Step 2: Determine the range exponentially $i = 1 \rightarrow A[1] = 4 \leq 14$ $i = 2 \rightarrow A[2] = 6 \leq 14$ $i = 4 \rightarrow A[4] = 10 \leq 14$ $i = 8 \rightarrow A[8] = 18 > 14 \rightarrow$ stop
Search range: low = 4 high = 8

-Step 3: Binary Search

$A[6] = 14 \rightarrow$ element found

EXAMPLE

Sorted array:

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```
A = [2, 4, 6, 8, 10, 12, 14, 16, 18]  
Target = 14
```

EXAMPLE

Step 1: Check the first element

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A[0] = 2 ≠ 14 → continue

EXAMPLE

Step 2: Determine the range exponentially

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```
i = 1 → A[1] = 4 ≤ 14
i = 2 → A[2] = 6 ≤ 14
i = 4 → A[4] = 10 ≤ 14
i = 8 → A[8] = 18 > 14 → stop
```

EXAMPLE

Search range:

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```
low = 4  
high = 8
```

EXAMPLE

Step 3: Binary Search

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```
A[6] = 14 → element found
```

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THANK YOU