Binary Search

Binary search. Given `value` and sorted array `a[]`, find index `i` such that `a[i] = value`, or report that no such index exists.

Invariant. Algorithm maintains `a[lo]` ≤ `value` ≤ `a[hi]`.

Ex. Binary search for 33.

6	13	14	25	33	43	51	53	64	72	84	93	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

↑   ↑

lo   **hi**

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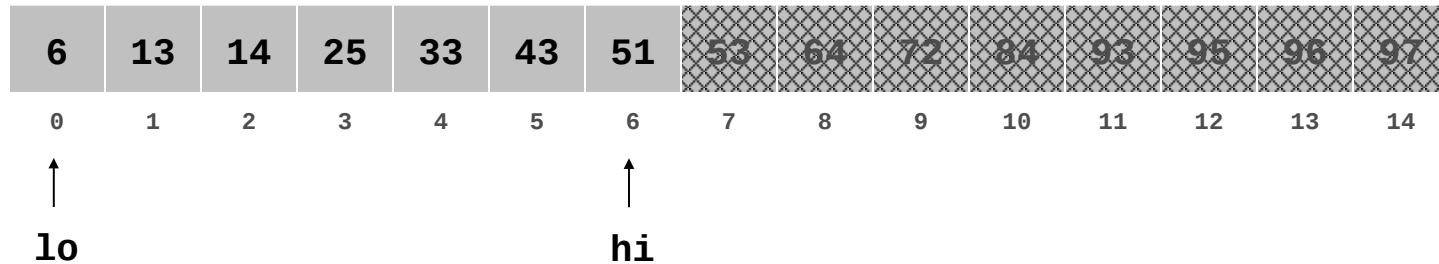
Ex. Binary search for 33.

6	13	14	25	33	43	51	53	64	72	84	93	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

lo   mid   hi

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lo   hi

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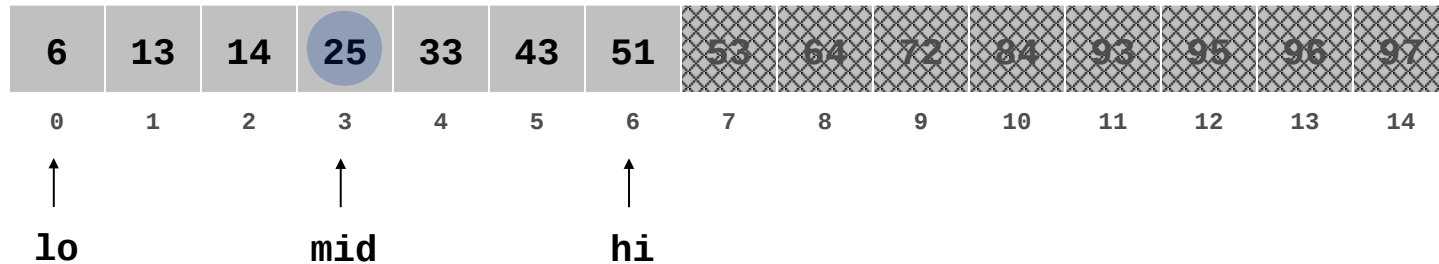Invariant. Algorithm maintains `a[lo]` ≤ `value` ≤ `a[hi]`.

Ex. Binary search for 33.

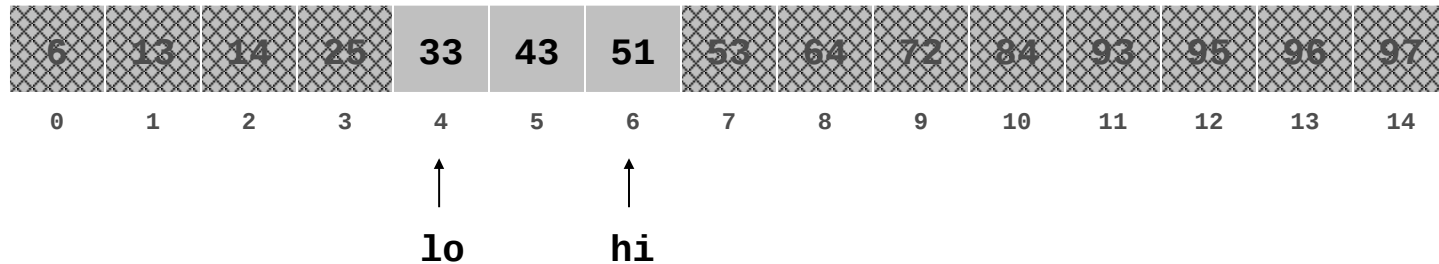| 6	13	14	25	33	43	51	53	64	72	84	93	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

↑ lo   ↑ mid   ↑ hi

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Ex. Binary search for 33.

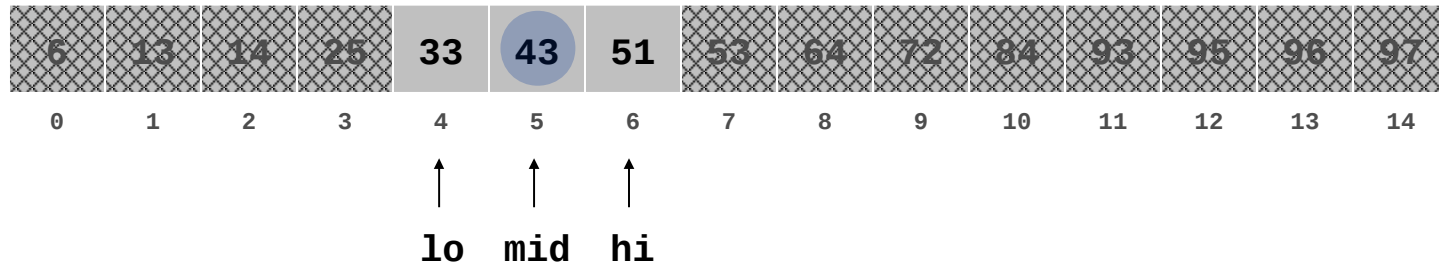| 6	13	14	25	**33**	**43**	**51**	53	64	72	84	93	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

lo = 4   **hi** = 6

Binary Search

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Ex. Binary search for 33.

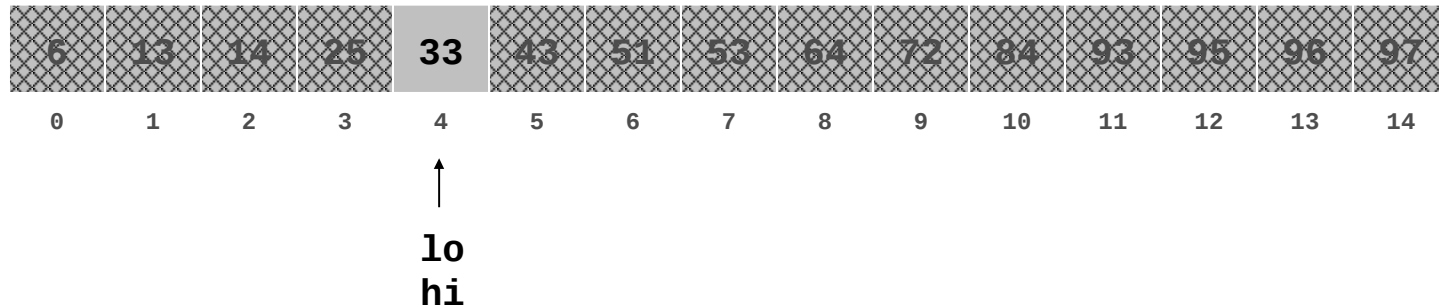| 6	13	14	25	33	43	51	53	64	72	84	93	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

↑ ↑ ↑

lo mid hi

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Ex. Binary search for 33.

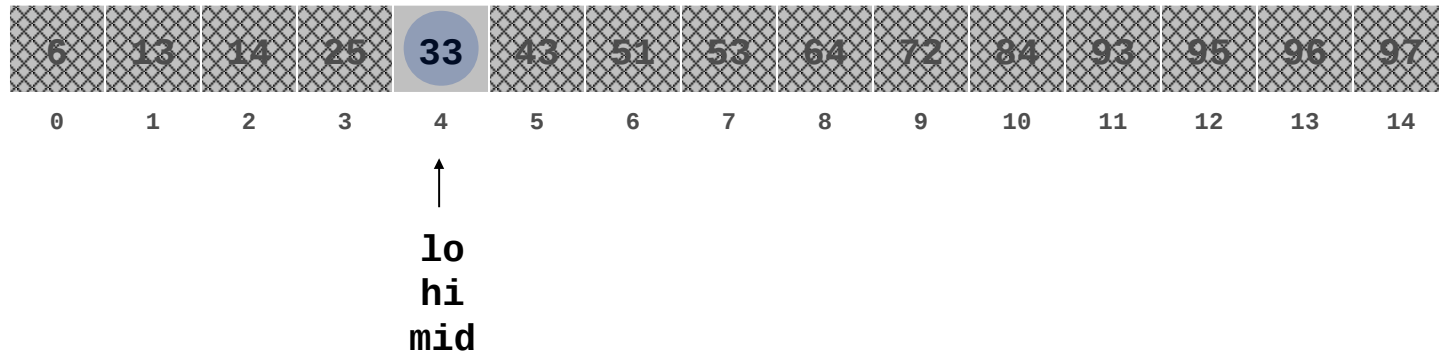| 6	13	14	25	**33**	43	51	53	64	72	84	93	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

↑

lo
hi

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↑
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```
lo
hi
mid
```