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]` $\leq$ `value` $\leq$ `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

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

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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

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.

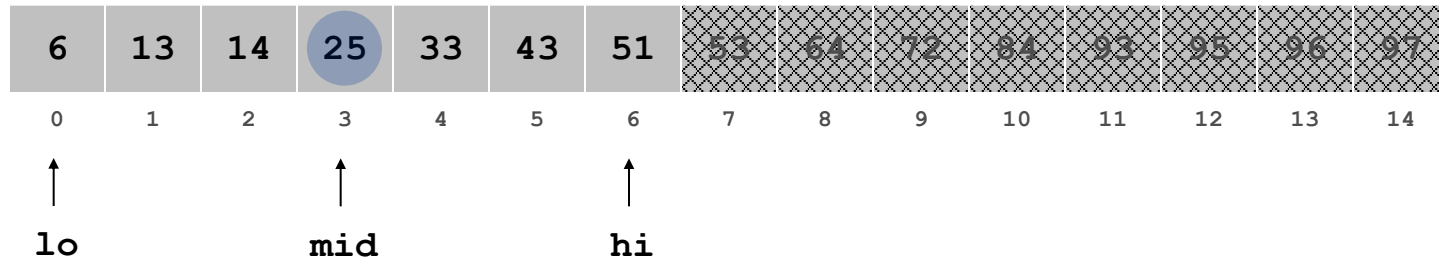| 6	13	14	25	33	43	51	53	64	72	84	91	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

lo   hi

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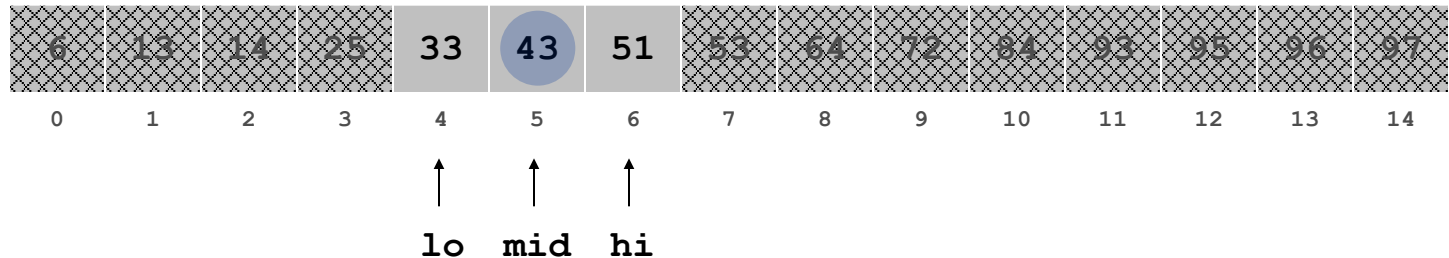| 6	13	14	25	33	43	51	53	64	72	84	93	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

lo (↑ at index 4)   **hi** (↑ at index 6)

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	91	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

                          ↑   ↑   ↑

                        `lo  mid  hi`

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.

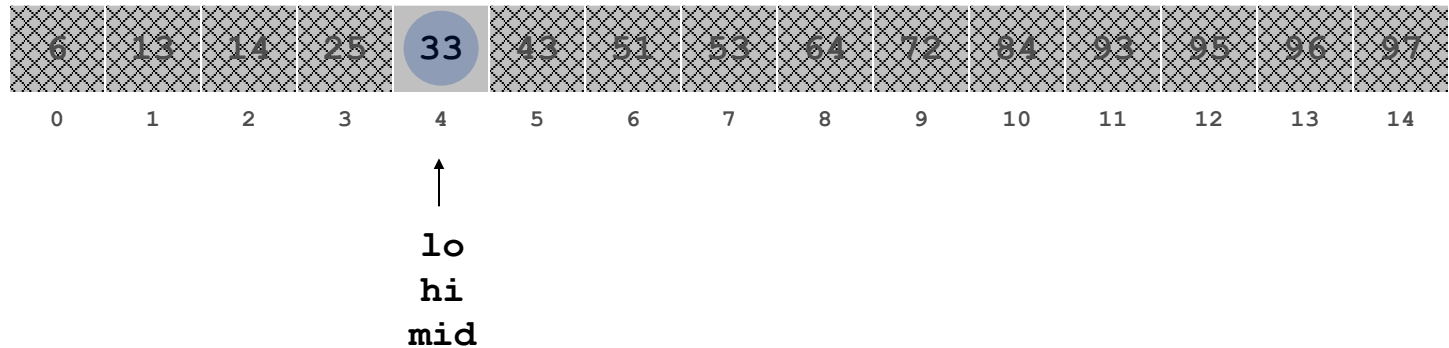Invariant. Algorithm maintains `a[lo]` ≤ `value` ≤ `a[hi]`.

Ex. Binary search for 33.

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
mid
```

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	91	95	96	97
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

```
lo
hi
mid
```