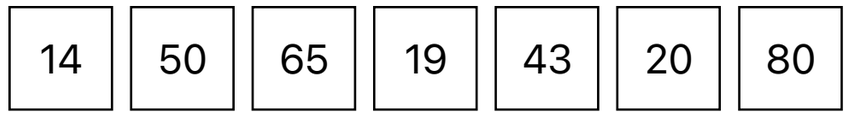
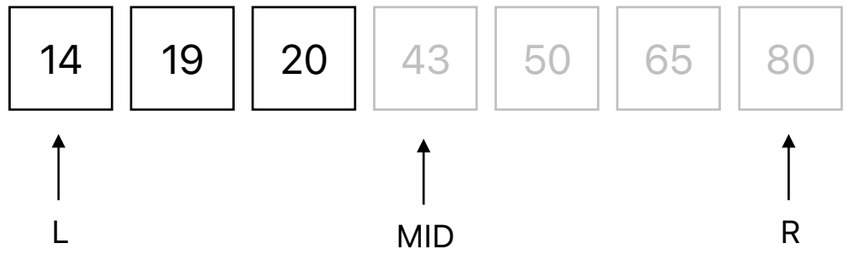
target = 20

arr

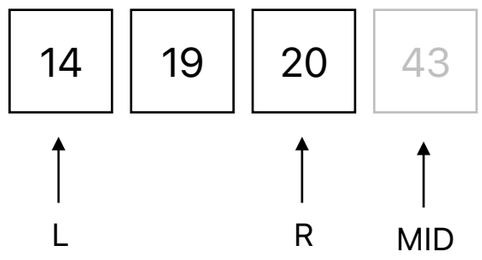


Must be sorted

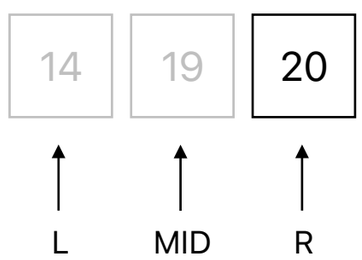
20 < 43



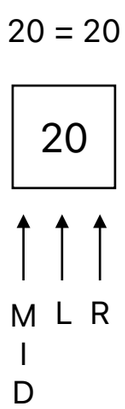
20 < 43



20 > 19



20 = 20



Time Complexity

time complexity?

$$40 \to 20 \to 10 \to \ldots \to 1$$

$$n \to \frac{n}{2} \to \frac{n}{4} \to \frac{n}{8} \to \ldots \to 1$$

$$n \to \frac{n}{2} \to \frac{n}{2^2} \to \frac{n}{2^3} \to \ldots \to \frac{n}{2^x} \approx 1$$

8 = 2^3

$$2^x \approx n$$

$$x \approx \log_2 n$$

$$O(\log_2 n) = O(\log n)$$

$$\log_2(10{,}000{,}000) = 23.253\ldots \approx 24$$

```kotlin
fun binarySearch(arr: Array<Int>, target: Int): Int {
    var left = 0
    var right = arr.size - 1
    var mid: Int
    while (left <= right) {
        mid = (left + right) / 2
        if (arr[mid] == target)
            return mid
        else if (target < arr[mid]) right = mid - 1
        else
            left = mid + 1
    }
    return -1
}
```

The time complexity of the binary search algorithm is **O(log n)**.