Step-by-step Binary search Algorithm

Original list:

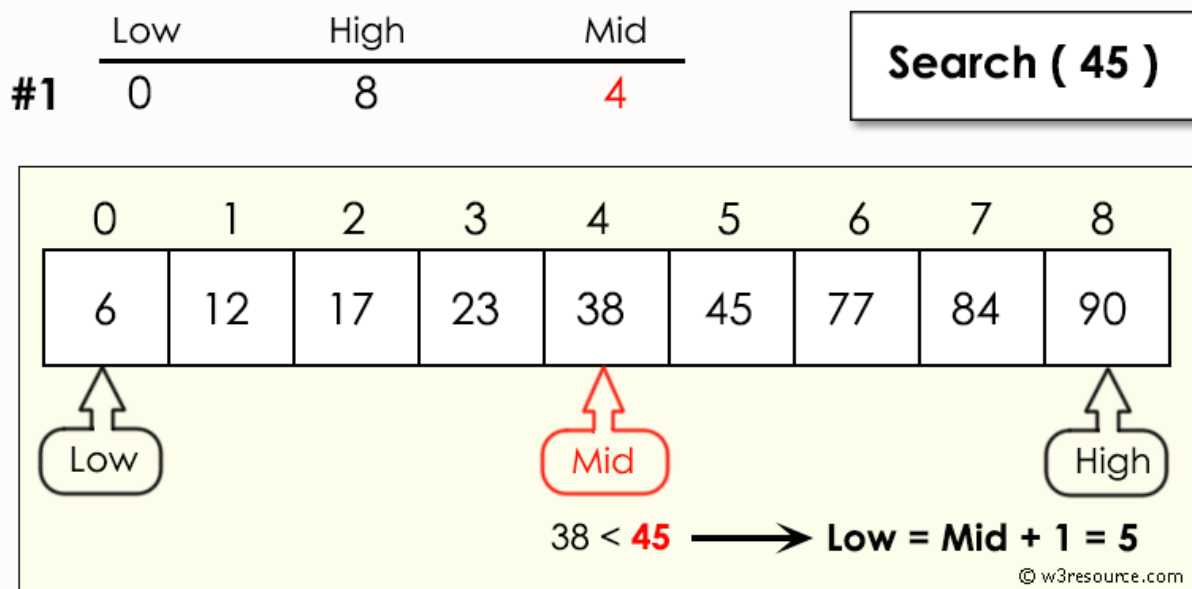|	0	1	2	3	4	5	6	7	8
Number	6	12	17	23	38	45	77	84	90

The goal is to search for the number 45.

Calculate the middle of the list using the following equation

$$mid = \left\lfloor \frac{low + high}{2} \right\rfloor$$

Mid is index position #4:

	Low	High	Mid	
#1	0	8	4	Search (45)

0	1	2	3	4	5	6	7	8
6	12	17	23	38	45	77	84	90
Low				Mid				High

38 < **45** ⟶ Low = Mid + 1 = 5

Next mid is index position #6:

	Low	High	Mid
#1	0	8	4
#2	5	8	6

0	1	2	3	4	5	6	7	8
					45	77	84	90

Low   Mid   High

High = Mid - 1 = 5 ← **45** < 77

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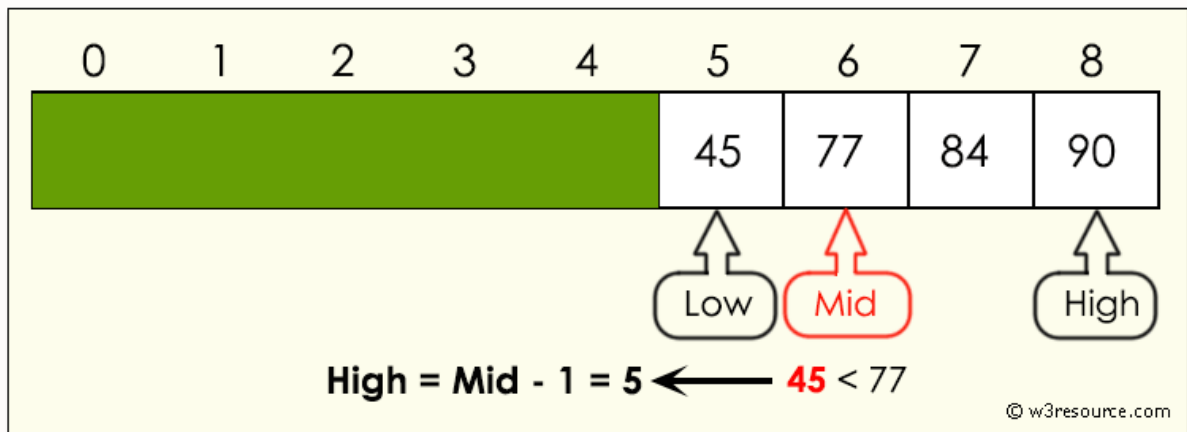
Last mid is index position #5:

	Low	High	Mid
#1	0	8	4
#2	5	8	6
#3	5	5	5

0	1	2	3	4	5	6	7	8
					45			

Successful Search !!

45 = = 45

Low   High   Mid

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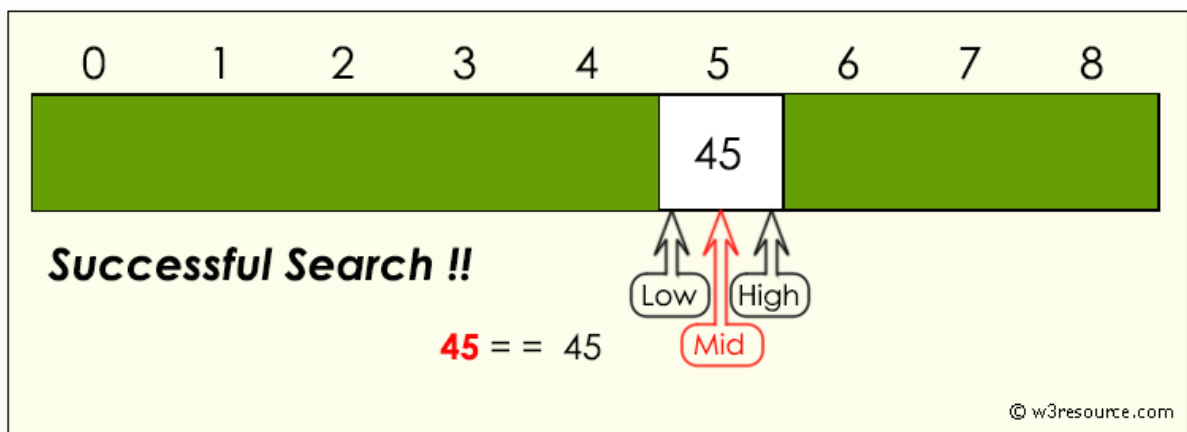
Successfully found number 45!

Flowchart of the binary search algorithm:

```
                              ┌──────────────────────────┐
                              │ def binary_search(item_  │
                              │        list,item)        │
                              └──────────────────────────┘
                                          │
                                          ▼
                              ┌──────────────────────────┐
                              │ first = 0                │
                              │ last = len(item_list)-1  │
                              │ found = False            │
                              └──────────────────────────┘
                                          │
                                          ▼
                              ◇ ( first<=last           ◇
                                  and not found) ?
                        No │                    │ Yes
                           ▼                    ▼
                 ┌──────────────┐      ┌──────────────────────┐
                 │ return found │      │ mid = (first + last)//2 │
                 └──────────────┘      └──────────────────────┘
                        │                        │
                        ▼                        ▼
                     ┌──────┐       ◇ item_list[mid] == item ? ◇
                     │ End  │
                     └──────┘          Yes │        │ No
                                           ▼        ▼
                 ┌──────────────┐   ◇ item < item_list[mid] ? ◇
                 │ found = True │
                 └──────────────┘     Yes │        │ No
                                          ▼        ▼
                          ┌──────────────┐   ┌──────────────────┐
                          │ last = mid - 1 │   │ first = mid + 1 │
                          └──────────────┘   └──────────────────┘
```