SORTING ALGORITHMS

INSERTION SORT

Insertion sort

- It is a simple sorting algorithm that builds the final sorted array one item at a time
- It has quadratic running time **O(N^2)**
- On large datasets it is very inefficient but on arrays with **10-20** items it is quite good
- Simple implementation !!!
- It is more efficient than other quadratic running time sorting procedures such as bubble sort or selection sort
- Adaptive algorithm → speeds up when array is already substantially sorted
- Stable sort → preserve the order of the items with equal keys

Insertion sort

- In-place algorithm → does not need any additional memory
- It is an online algorithm → it can sort an array as it receives it for example downloading data from web
- Hybrid algorithms uses insertion sort if the subarray is small enough

  Insertion sort is faster for small subarrays than quicksort !!!
- Variant of insertion sort is shell sort
- Sometimes selection sort is better: they are very similar algorithms
- Insertion sort requires more writes because the inner loop can require shifting large sections of the sorted portion of the array
- In general, insertion sort will write to the array **O(n2)** times while selection sort will write only **O(n)** times
- For this reason selection sort may be preferable in cases where writing to memory is significantly more expensive than reading → for example flash

Pseudocode

```
insertionSort(array)

    for i=1 to length(array)
        j = i

        while j > 0 and array[j-1] > array[j]
            swap( array, j, j-1 )
            j = j – 1
        end
    end
end
```

Pseudocode

```
insertionSort(array)

    for i=1 to length(array)
        j = i

        while j > 0 and array[j-1] > array[j]
            swap( array, j, j-1 )
            j = j – 1
        end
    end
end
```

We iterate through the array sequentially !!!

Pseudocode

```
insertionSort(array)

    for i=1 to length(array)
        j = i

        while j > 0 and array[j-1] > array[j]
            swap( array, j, j-1 )
            j = j – 1
        end
    end
end
```

While the previous item is greater than the given one, we keep swapping them !!!

~ thats why there are so many shifts in insertion sort

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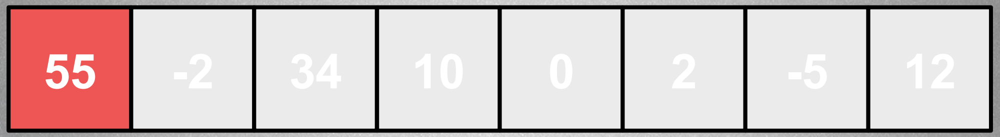
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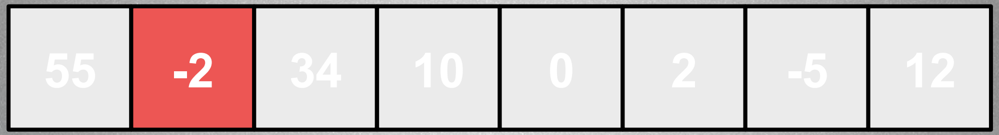
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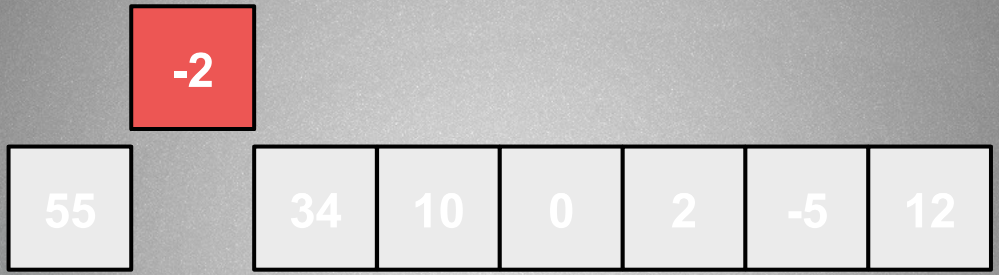
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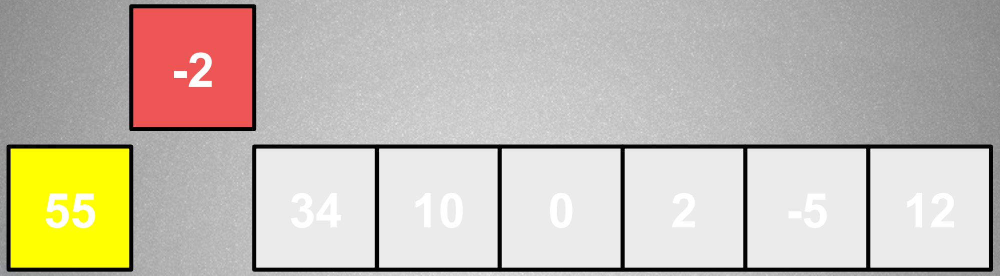
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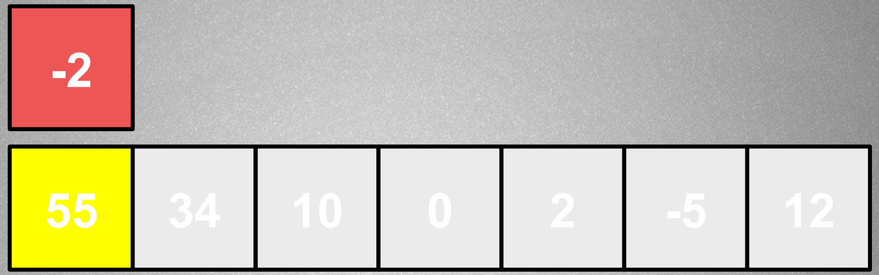
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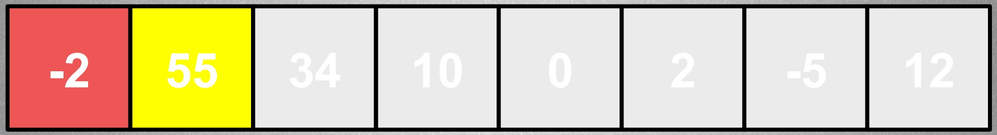
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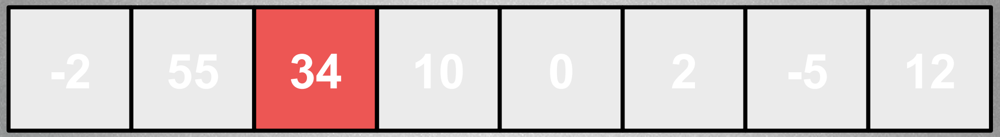
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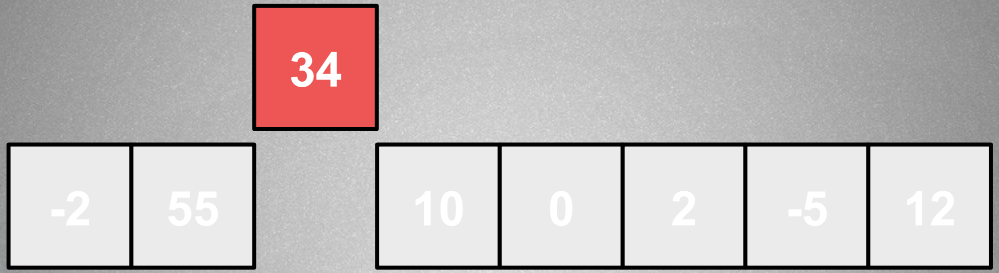
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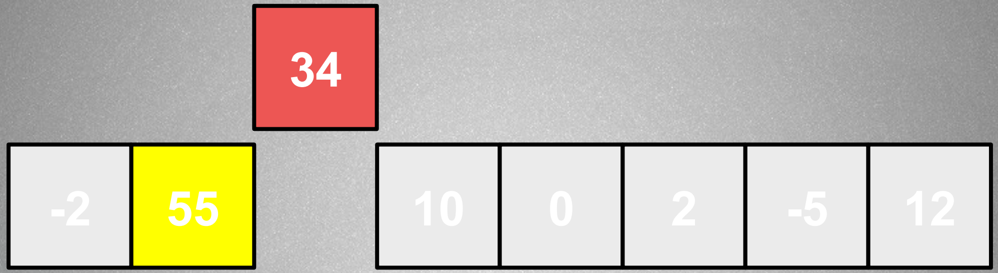
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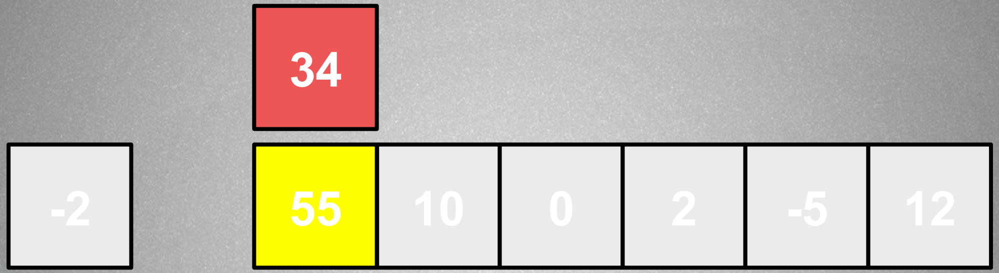
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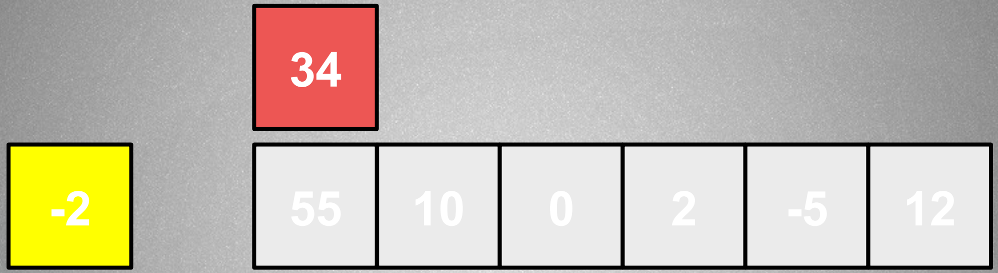
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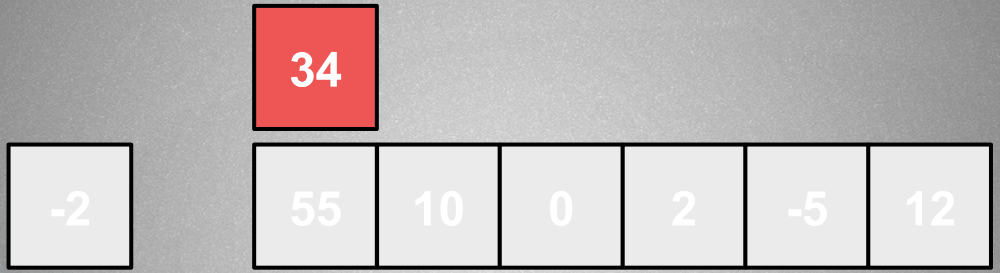
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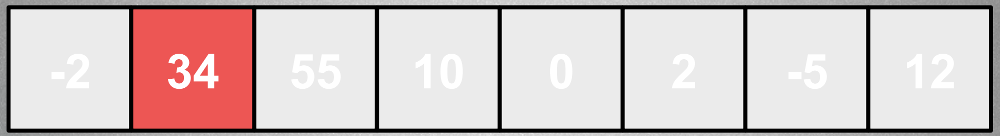
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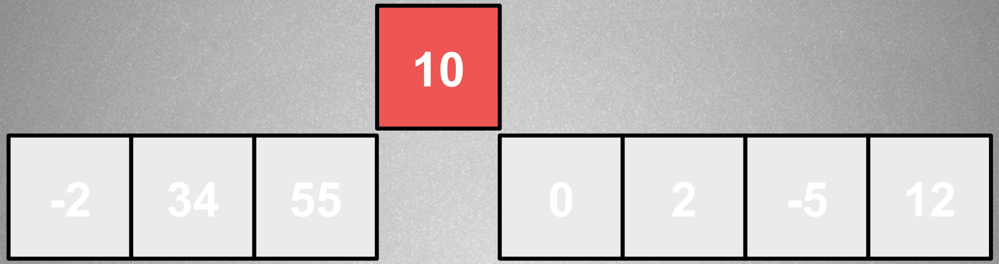
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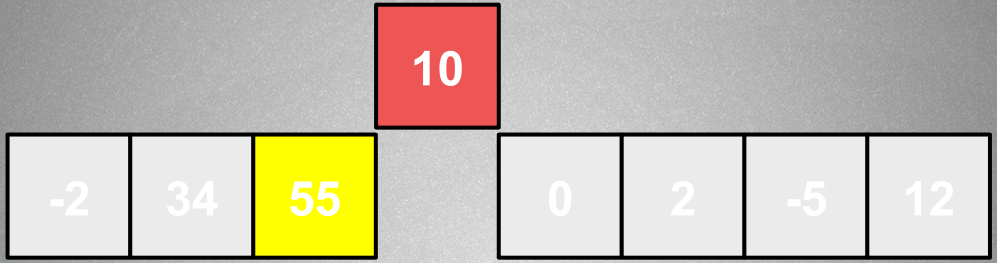
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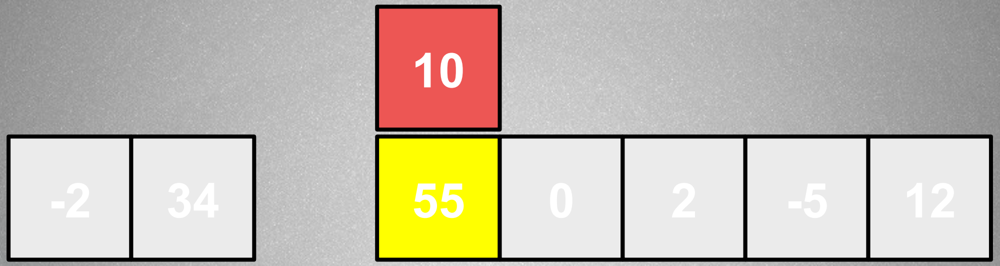
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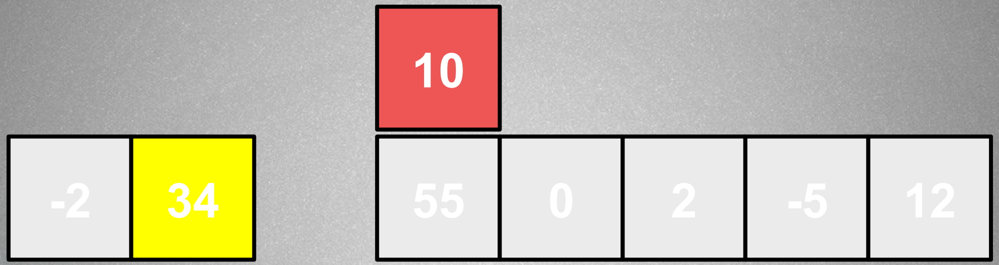
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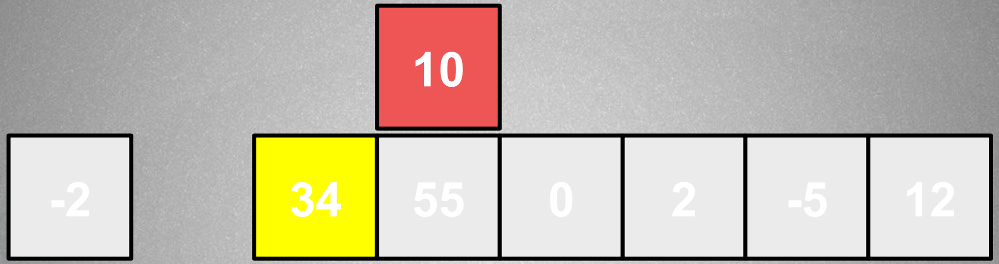
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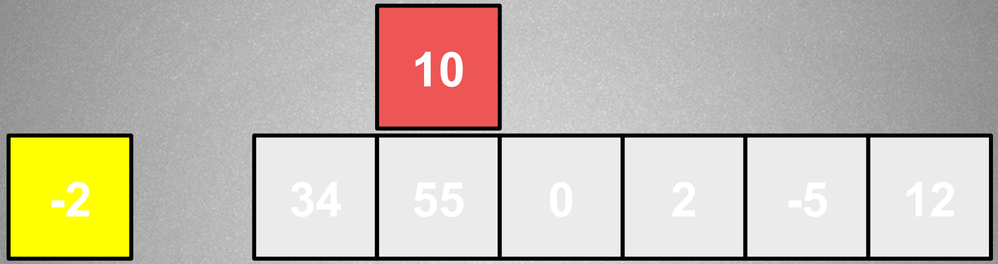
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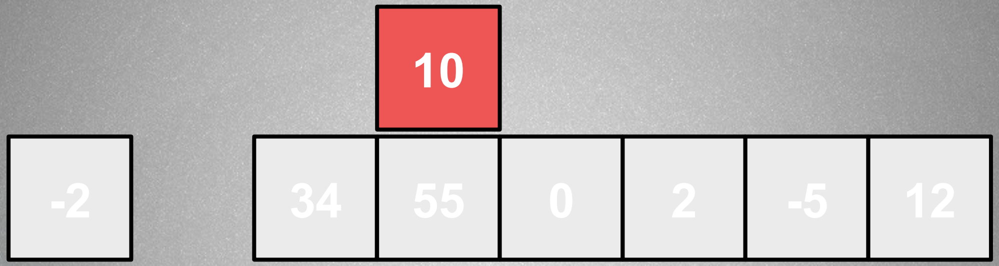
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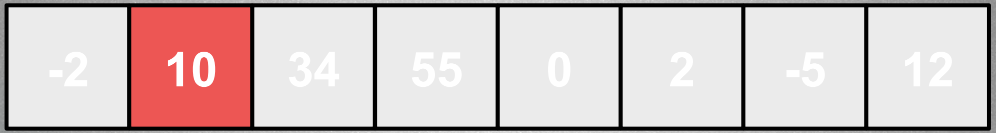
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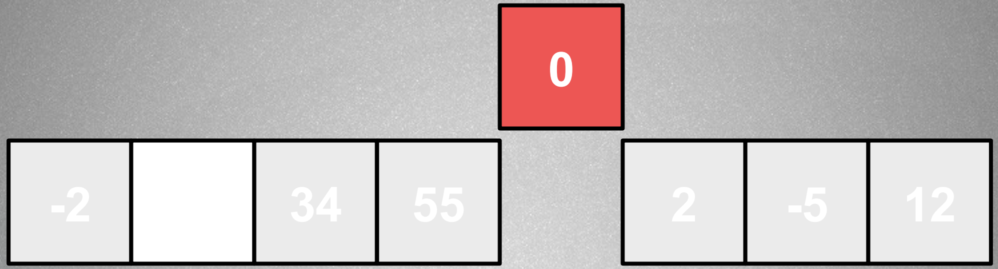
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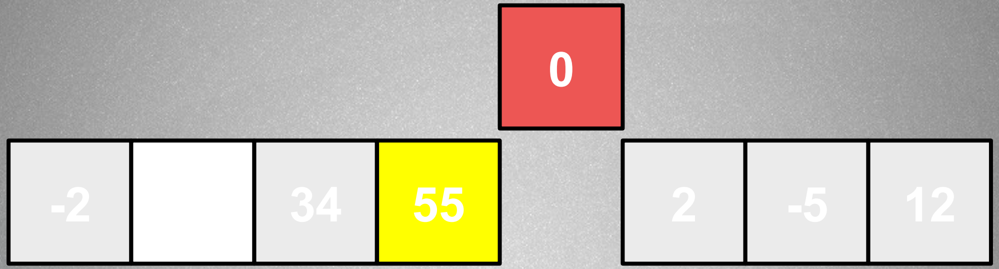
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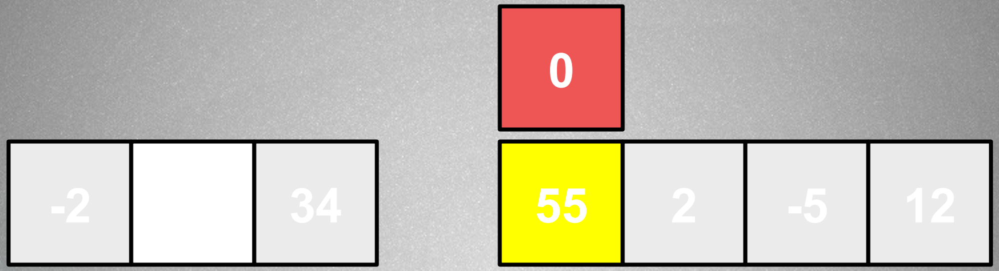
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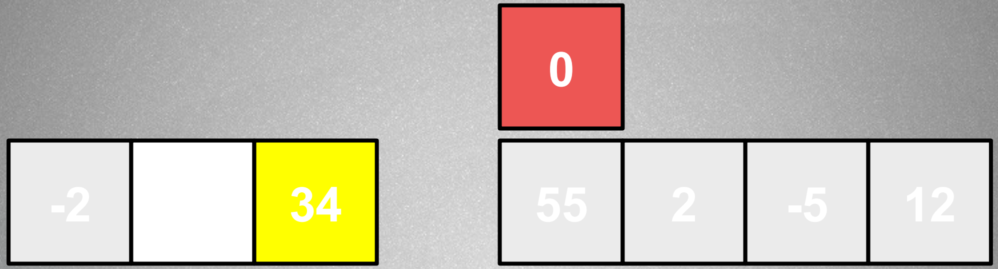
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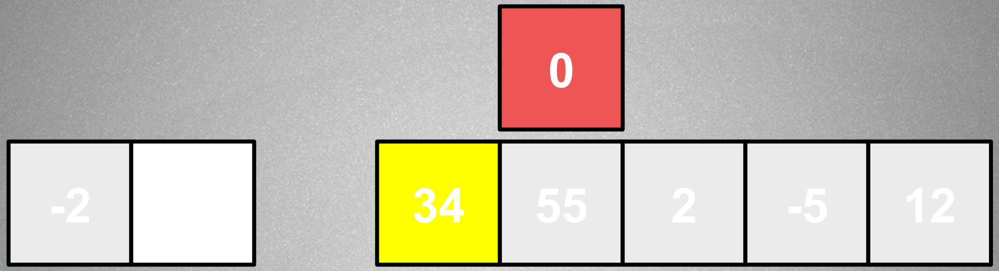
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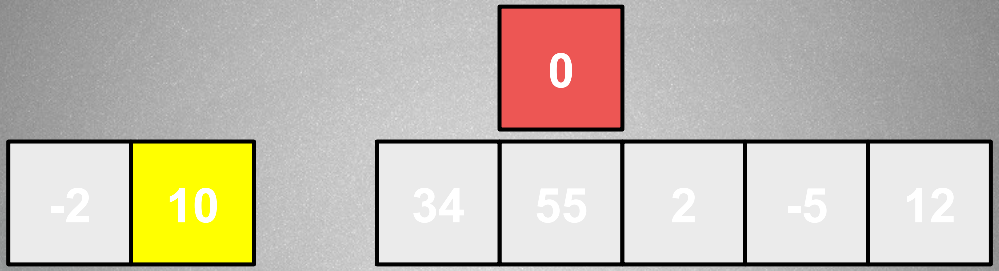
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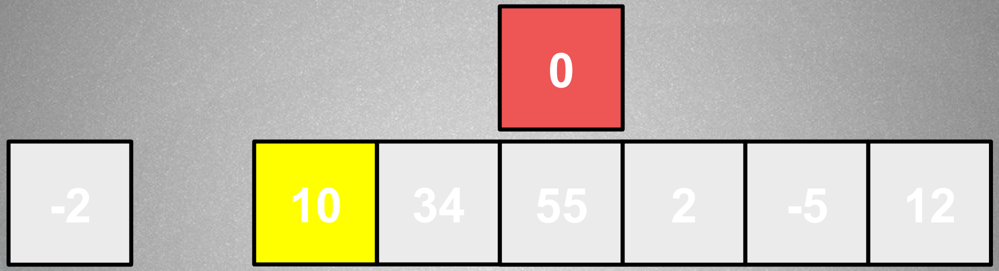
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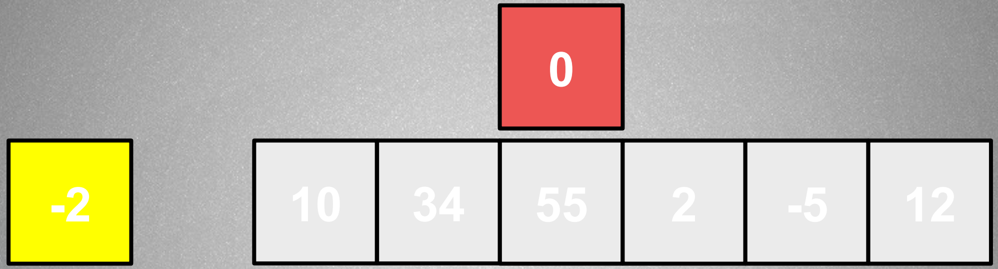
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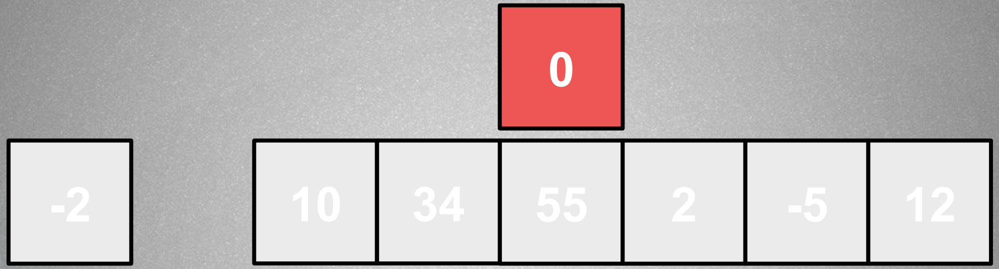
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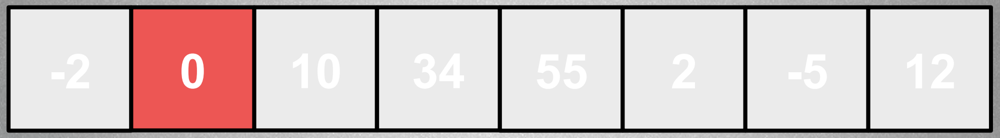
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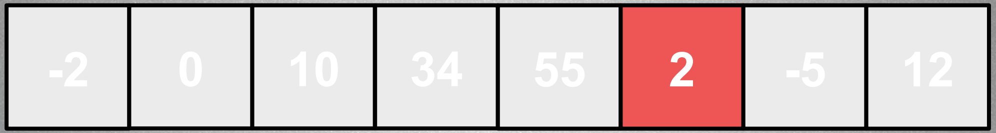
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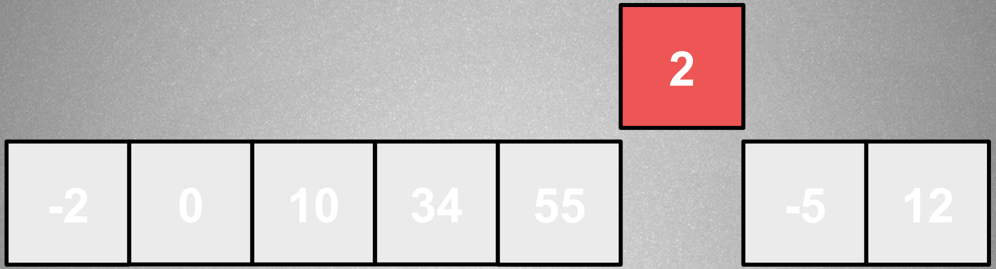
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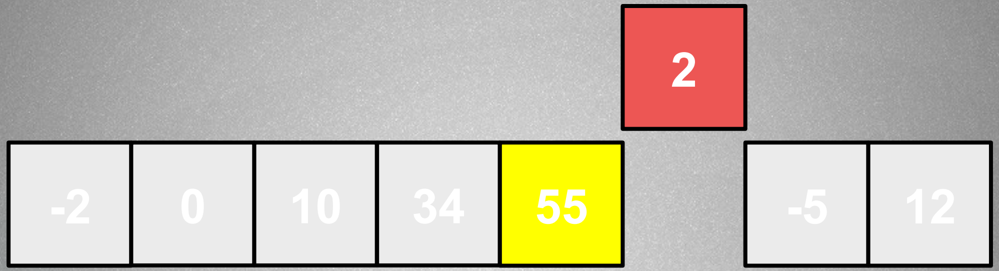
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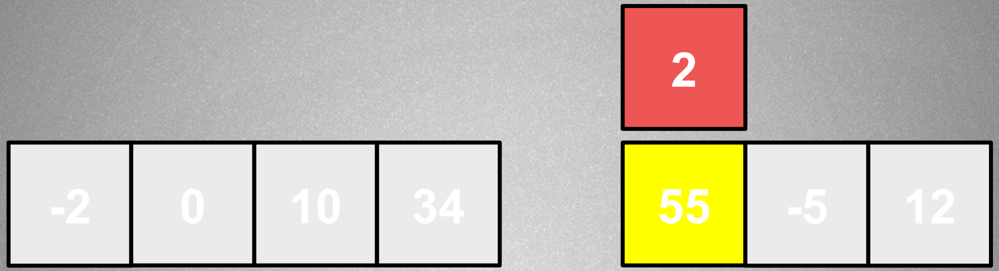
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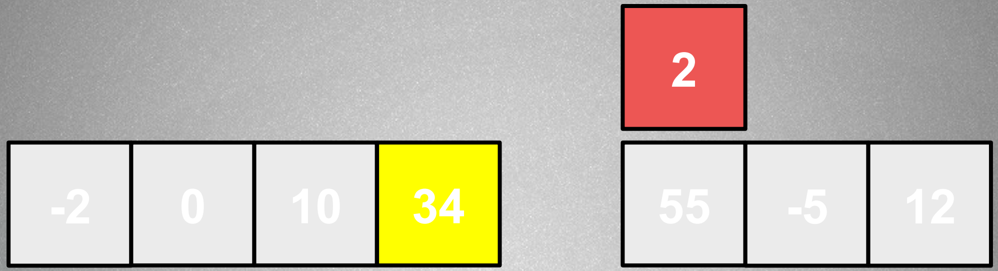
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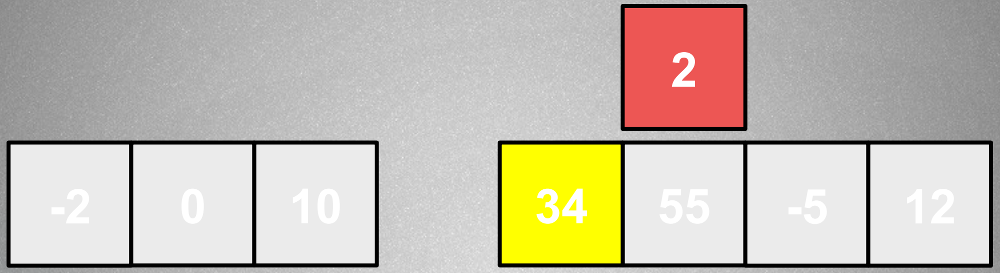
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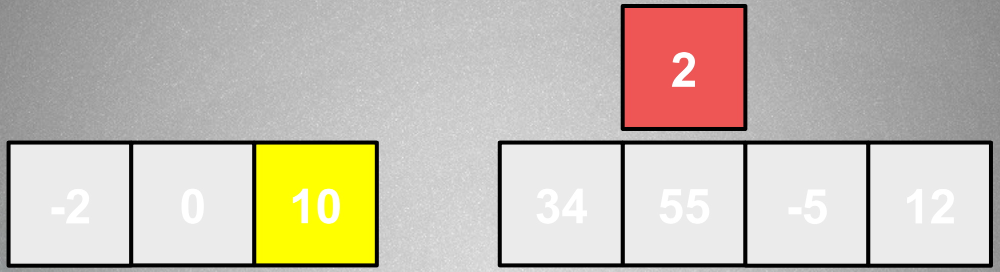
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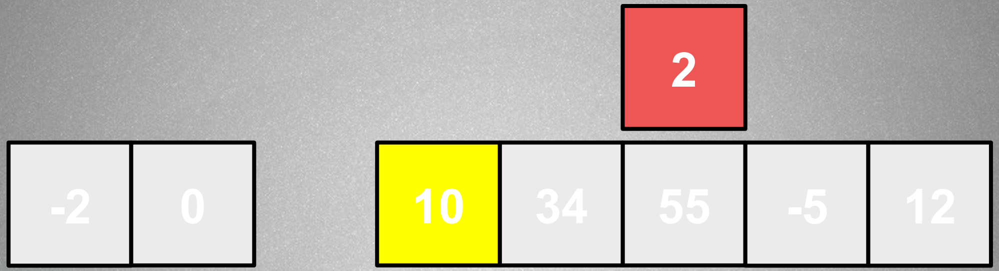
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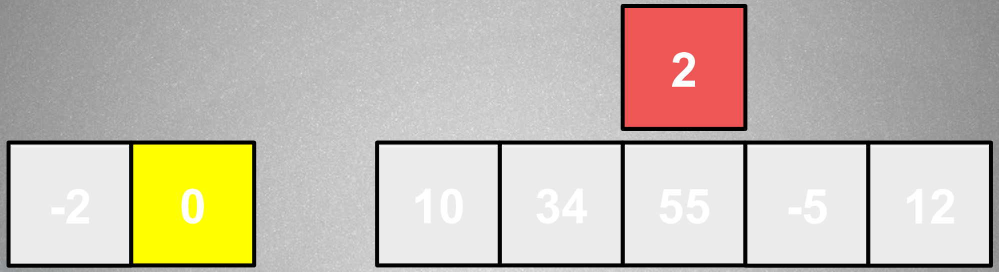
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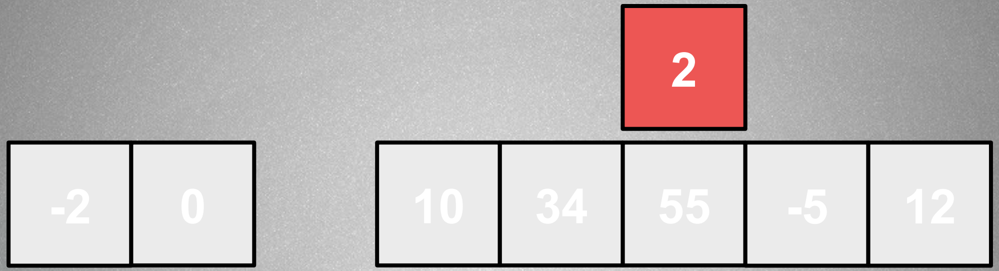
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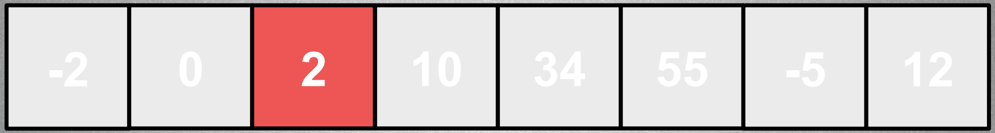
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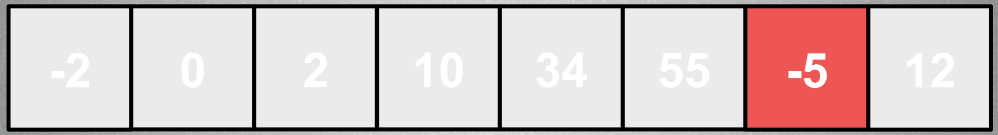
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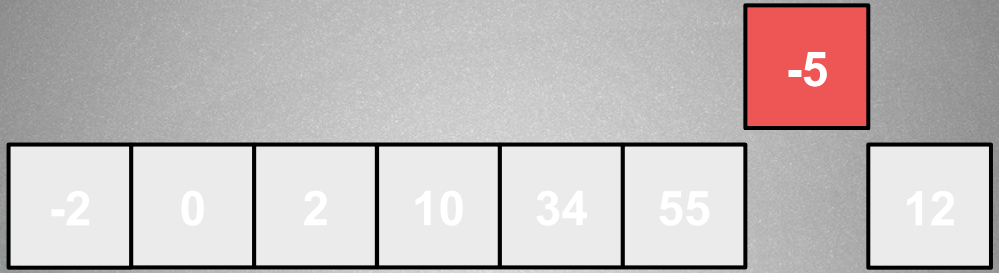
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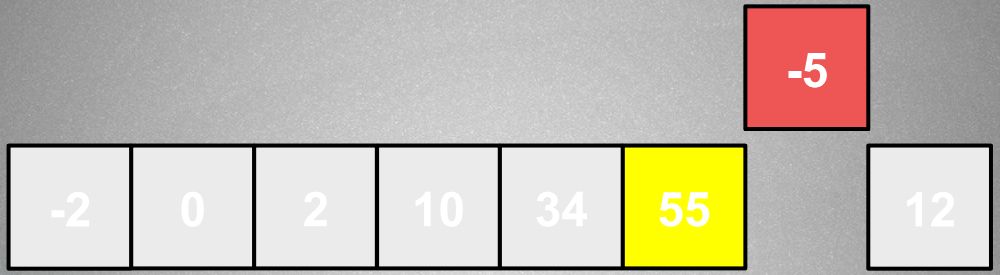
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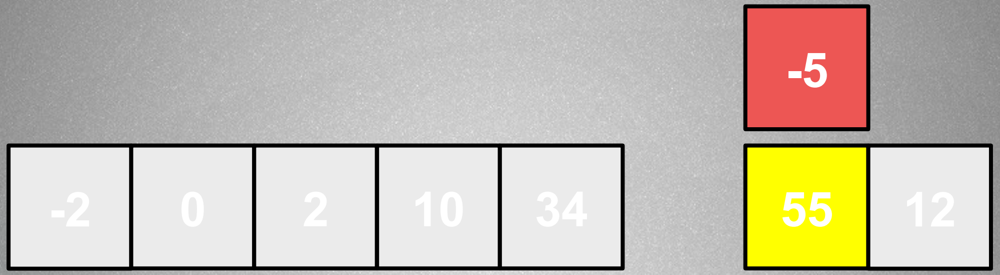
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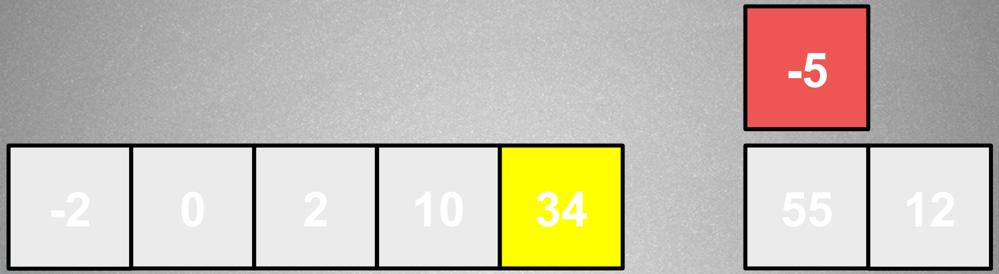
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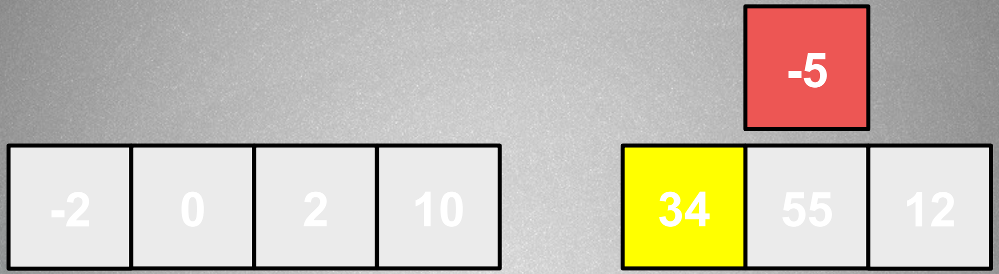
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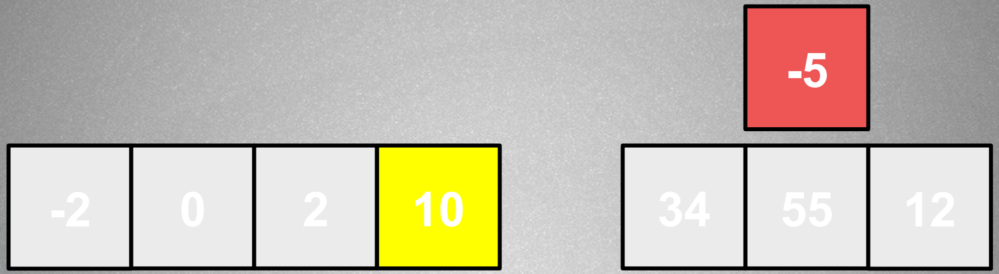
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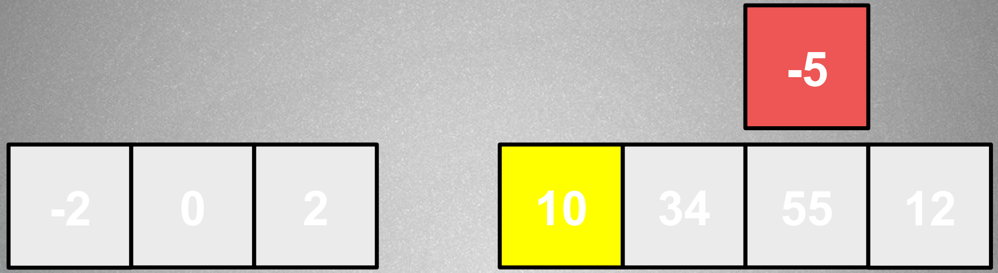
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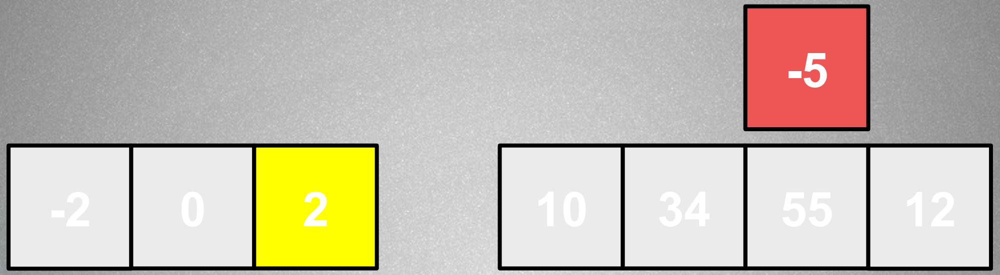
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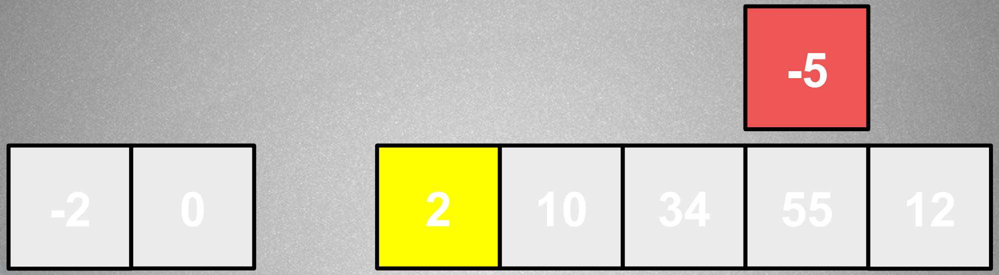
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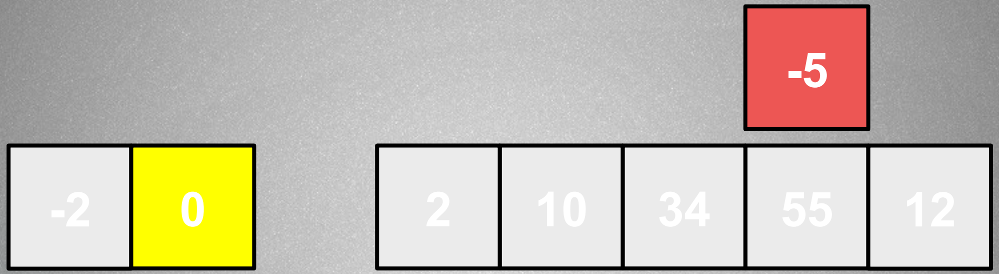
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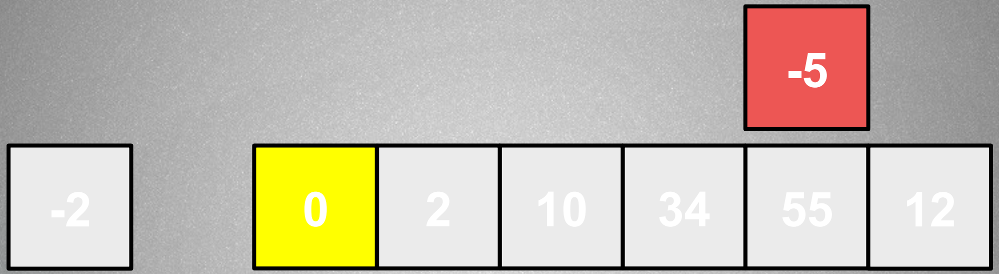
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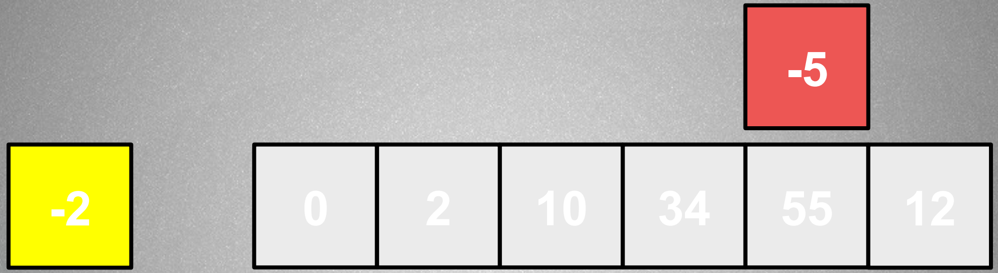
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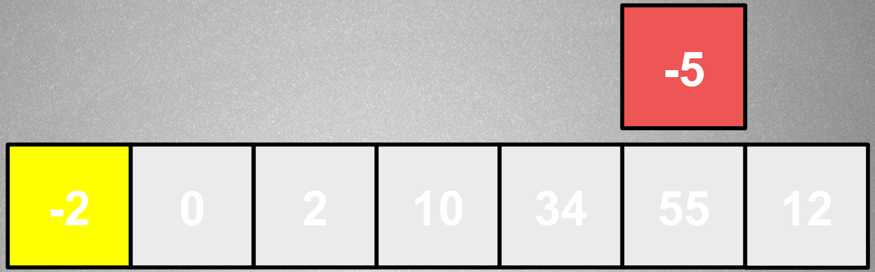
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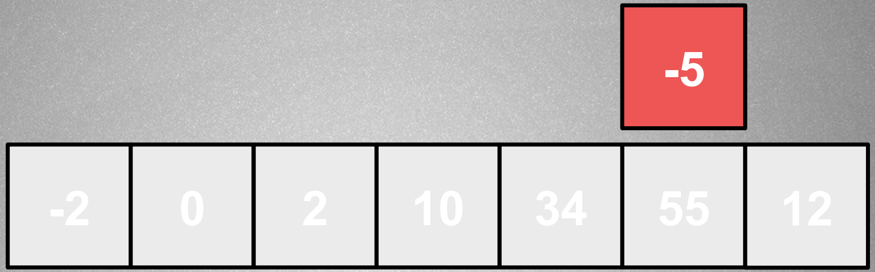
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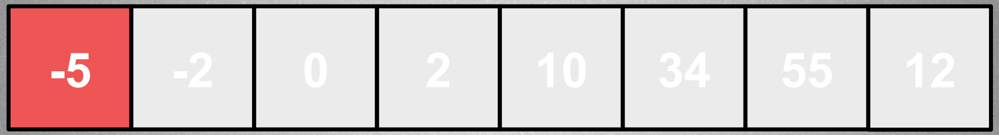
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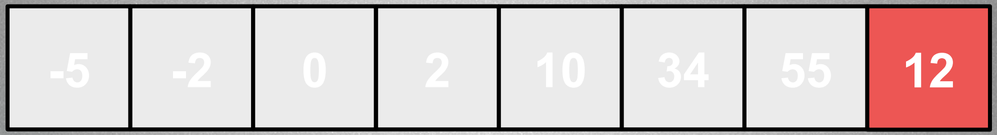
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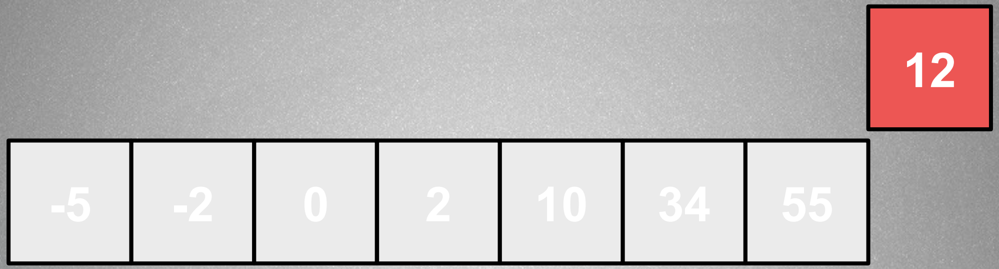
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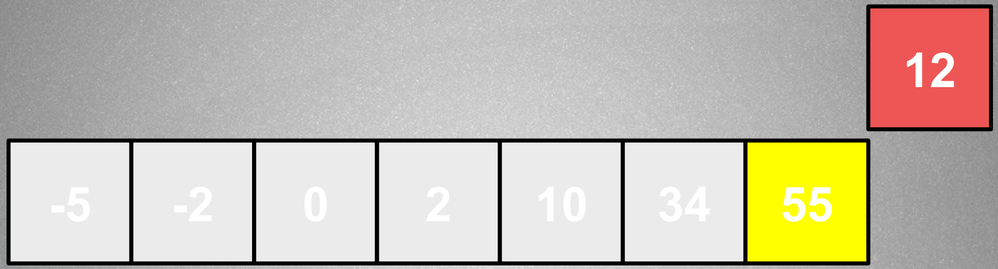
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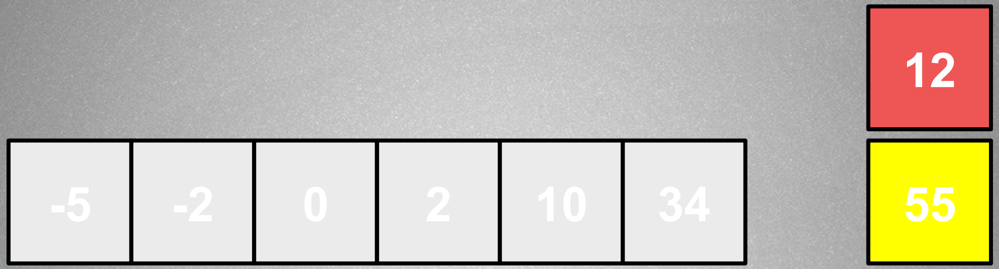
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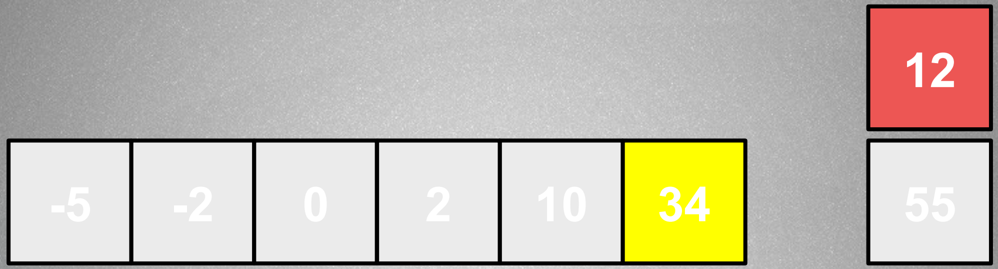
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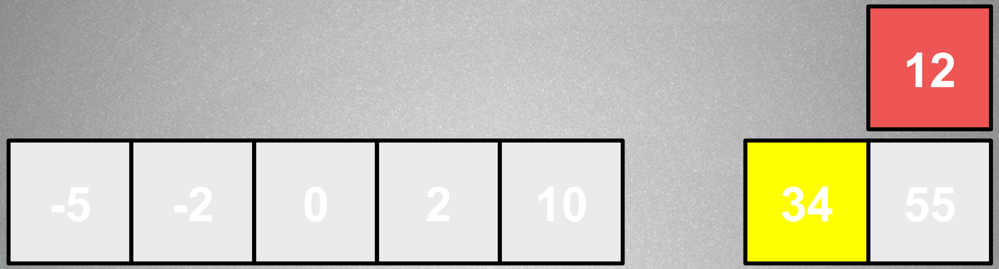
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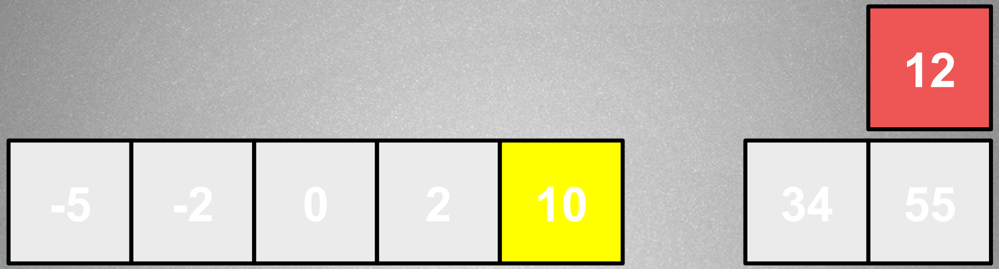
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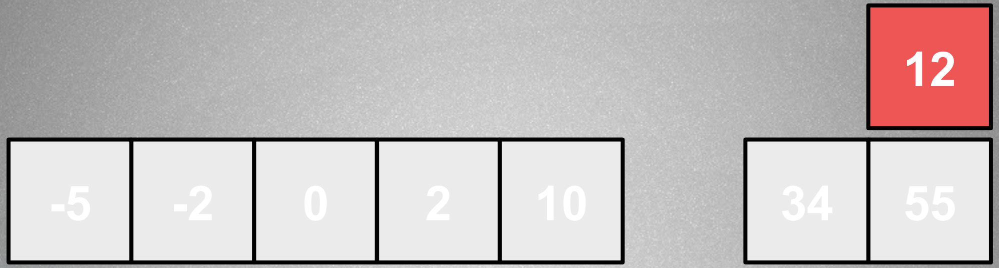
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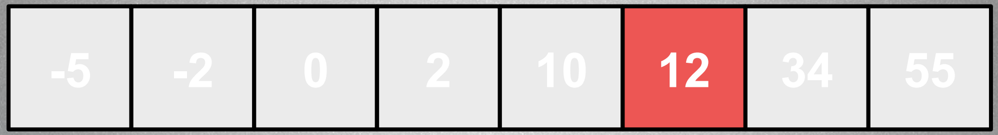
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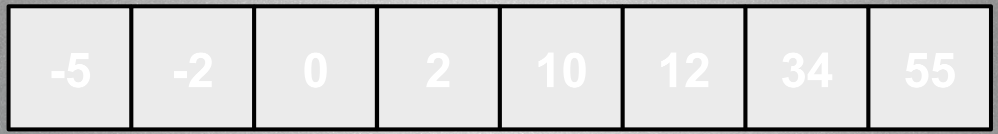
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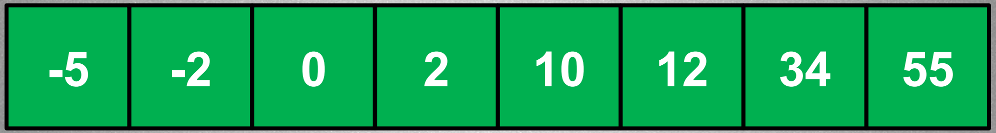
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