# Merge Sort

# Merge sort

- Merge sort is a sorting technique based on divide and conquer technique. With worst-case time complexity being O(n log n), it is one of the most respected algorithms.
- Merge sort first divides the array into equal halves and then combines them in a sorted manner.

# In the Beginning…

Invented by

John von Neumann (1903-1957)

- Follows divide and conquer paradigm.
- Developed merge sort for EDVAC in 1945

# Divide And Conquer

1. Divide: Divide the unsorted list into two sub lists of about half the size.
2. Conquer: Sort each of the two sub lists recursively until we have list sizes of length 1,in which case the list itself is returned.
3. Combine: Merge the two-sorted sub lists back into one sorted list.

# MERGE SORT ALGO

- MERGE SORT (*A*,*p*,*r*)  //divide
  if p < r
    then *q*= [ (p + r) / 2 ]
      MERGE SORT(*A*,*p*,*q*)
      MERGER SORT(*A*,*q* + 1,*r*)
      MERGE(*A*,*p*,*q*,*r*)

```
Merge(array A, int p, int q, int r)
        {
        array B[p..r]                   //temp array taken
        i = k = p                       //  initialize pointers
        j = q+1
        while (i <= q and j <= r)
                {
                 if (A[i] <= A[j]) B[k++] = A[i++]
                 else B[k++] = A[j++]
                }
        while (i <= q)
                B[k++] = A[i++]         // copy any leftover to B
       while (j <= r)
                B[k++] = A[j++]

       for i = p to r
                 A[i] = B[i]            // copy B back to A

       }
```

# Merge Sort Example

| 99 | 6 | 86 | 15 | 58 | 35 | 86 | 4 | 0 |
|---|---|---|---|---|---|---|---|---|

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|---|---|---|---|---|---|---|---|---|

| 99 | 6 | 86 | 15 |
|---|---|---|---|

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|---|---|---|---|---|

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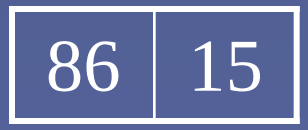



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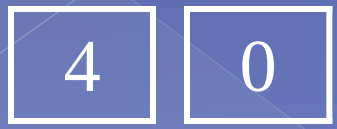

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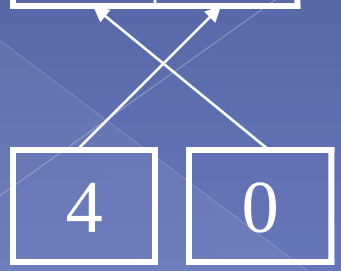
Merge



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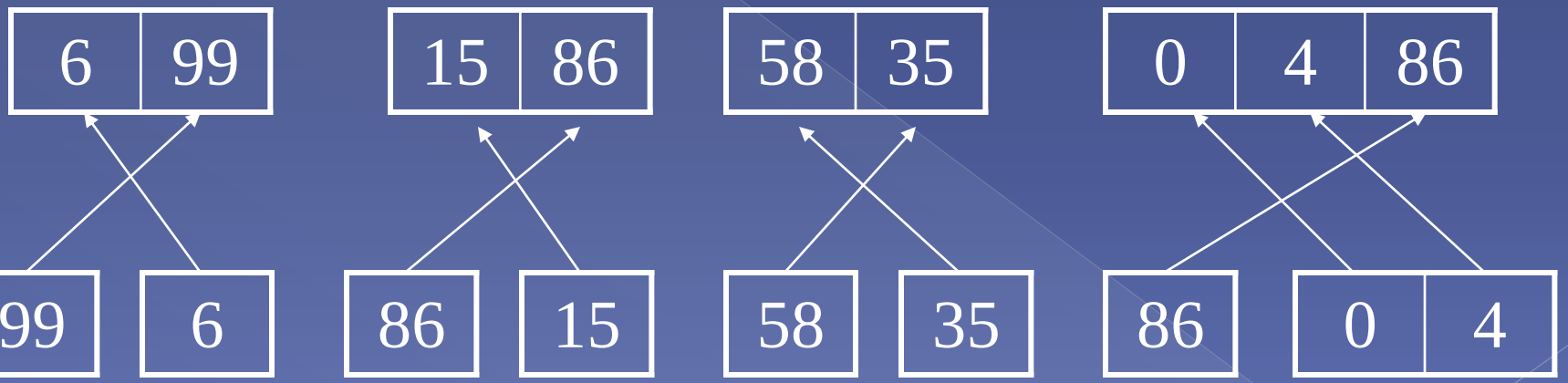


Merge

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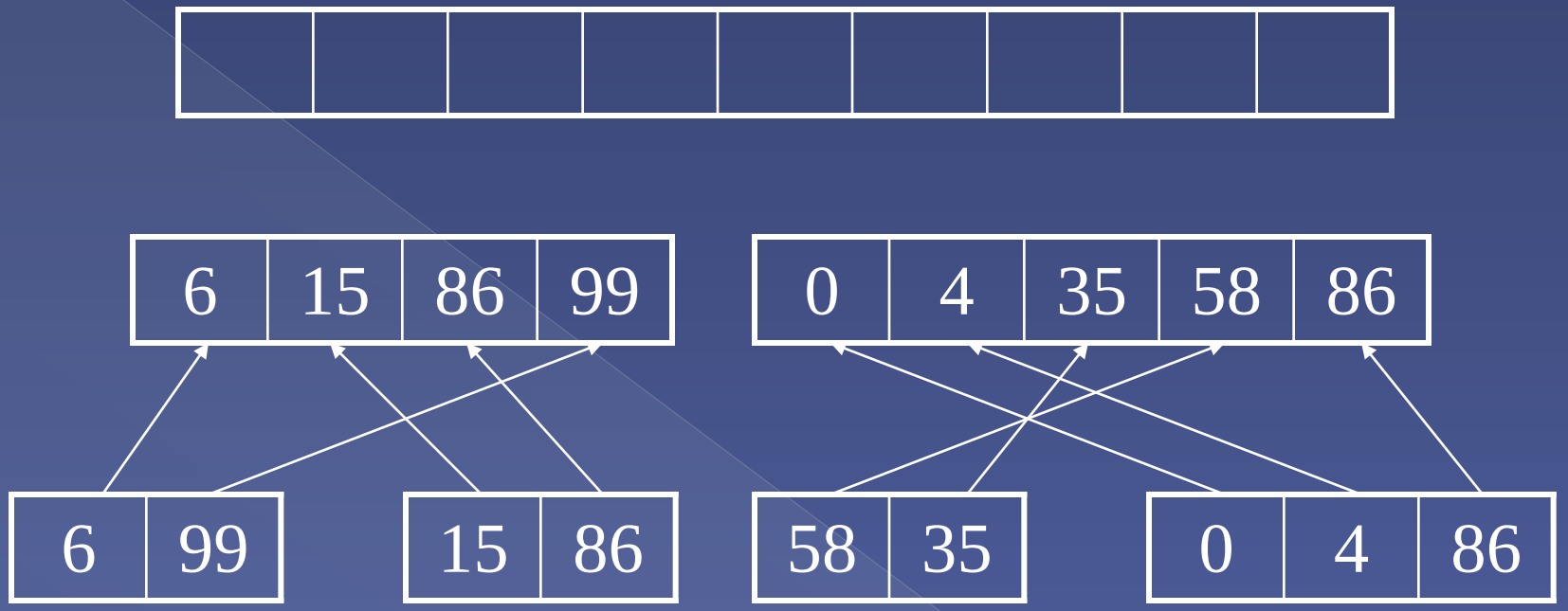


Merge

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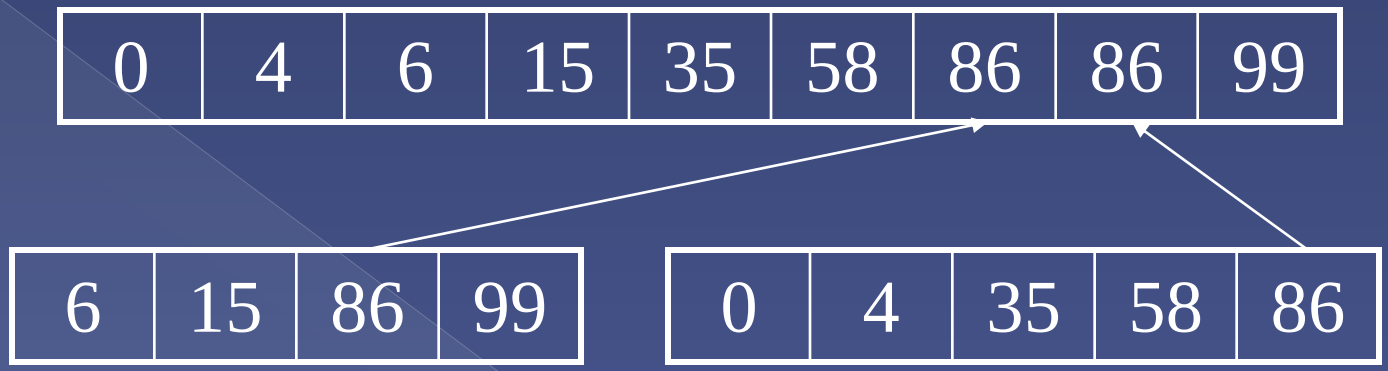


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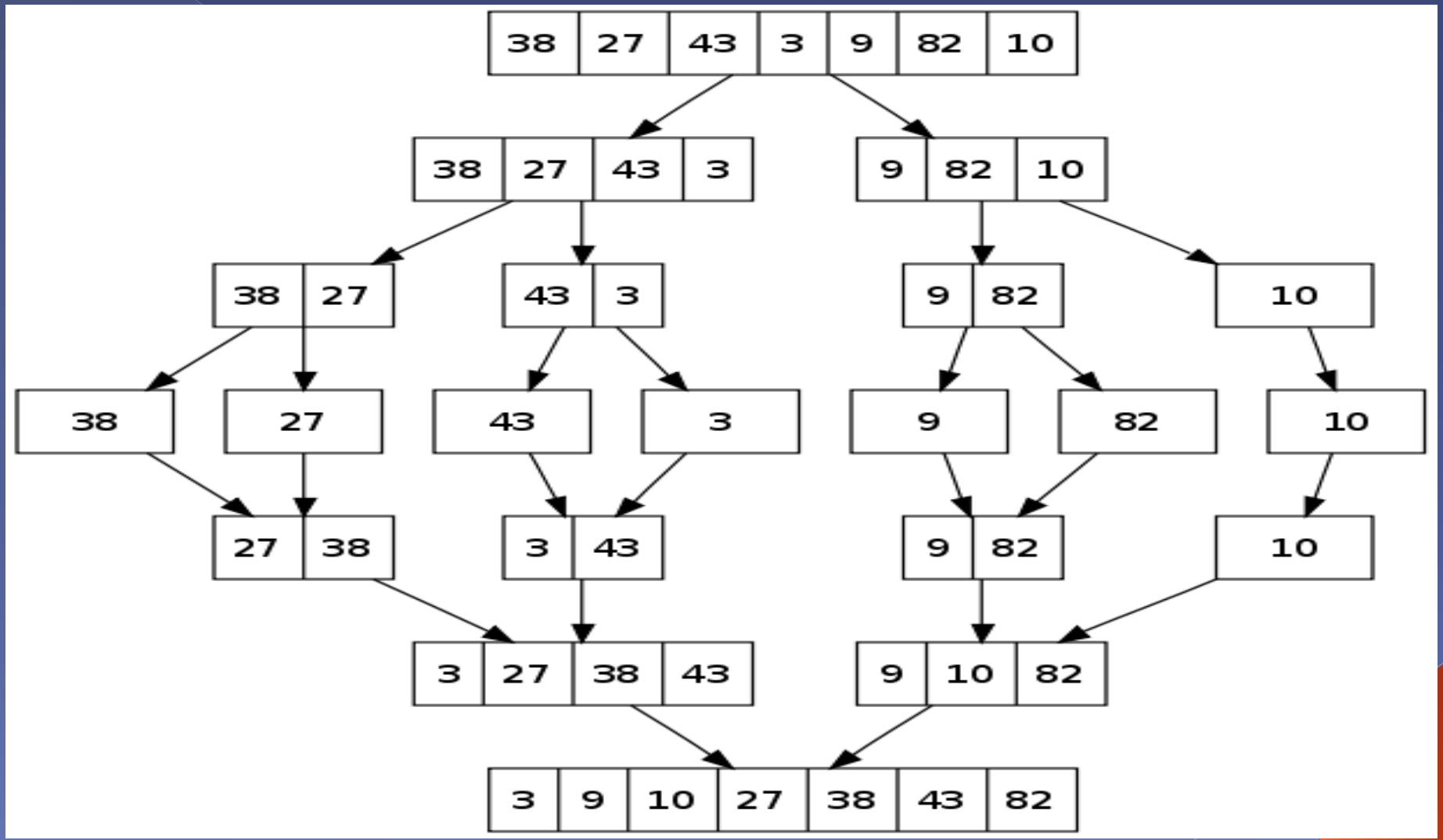


Thank you