

Merge Sort

Do now

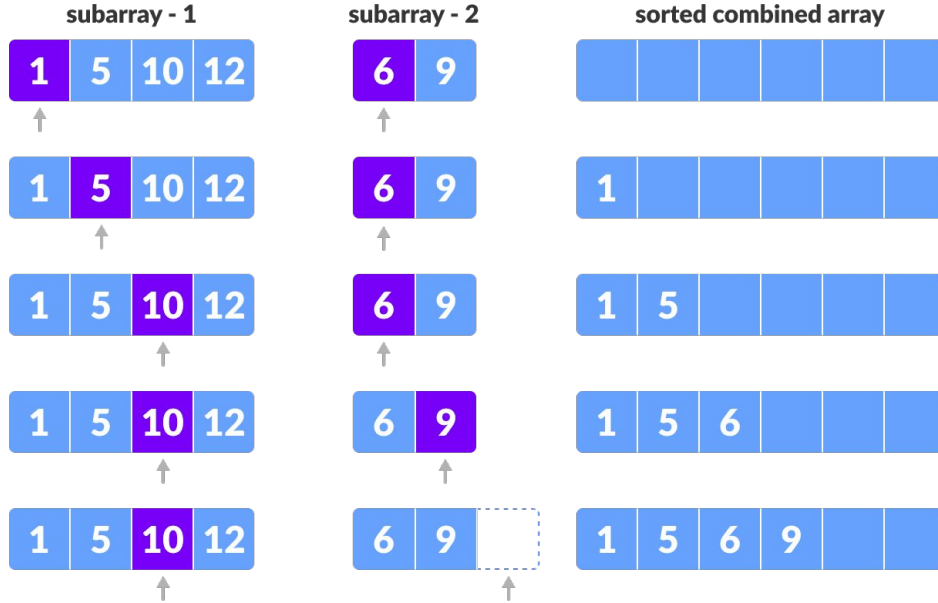
If we have 2 sorted arrays, how would you combine them to have only 1 sorted array?

Input: [4, 8, 9, 20, 25] [2, 5, 7, 12, 30]

Output: [2, 4, 5, 7, 8, 9, 12, 20, 25, 30]



Merging arrays



Since there are no more elements remaining in the second array, and we know that both the arrays were sorted when we started, we can copy the remaining elements from the first array directly.



How can we write a merge method in Java?
Parameters?
Return?

How can we write a merge method?

```
public static int[] merge(int [] left, int[] right){  
    }  
}
```

```
public static void merge(int[] destination, int [] left, int[]  
    right){  
    }  
}
```

Save your code here: `classwork/xx_merge/Merge.java`



Merge sort process

Recursive algorithm: It splits the array in half until it cannot be further divided.

Base case: When the array becomes empty or has only one element.

Recursive case: If the array has multiple elements, split the array into halves and recursively invoke the merge sort on each of the halves.

When both halves are sorted, the merge operation is applied, which means we have to combine two smaller sorted array to eventually make a larger one.



Merge Sort

Steps:

1. It divides an array into smaller subarrays.
2. It sorts each subarray.
3. It merges the sorted subarrays back together to form the final sorted array.

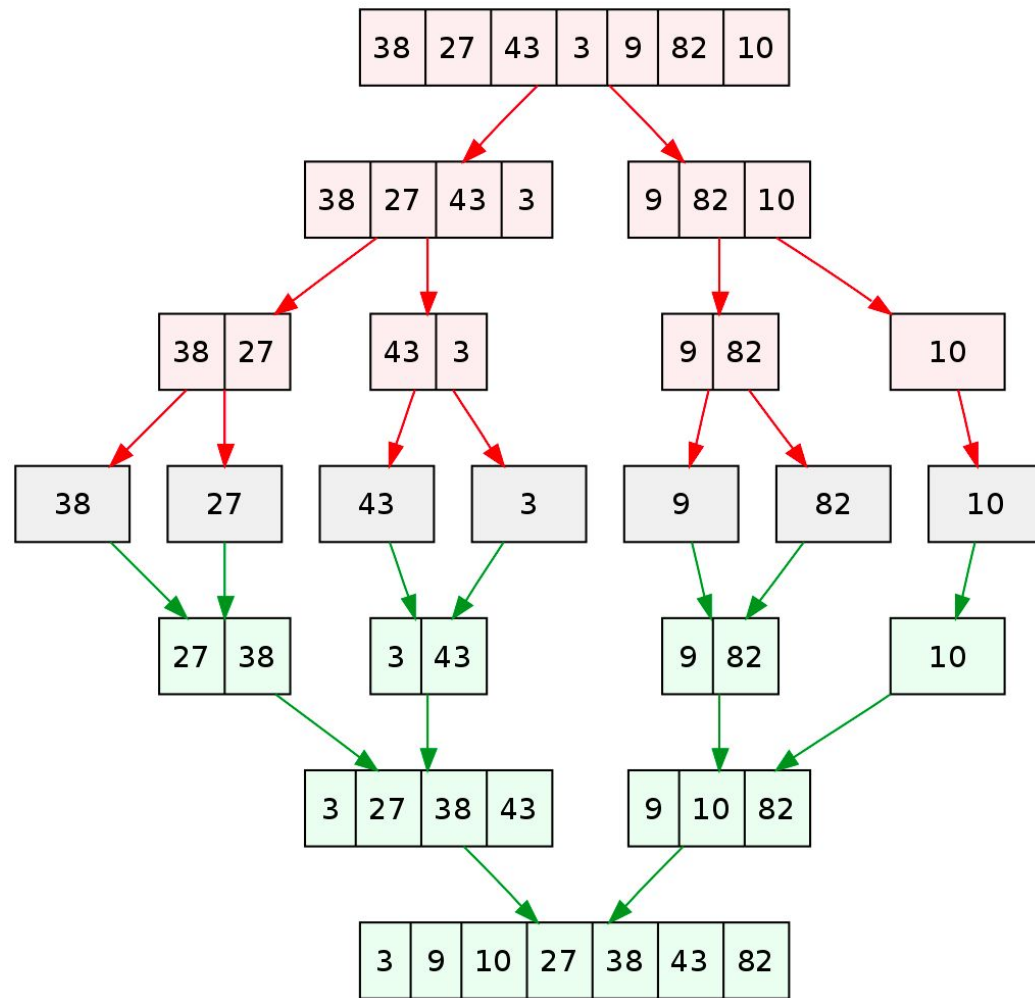


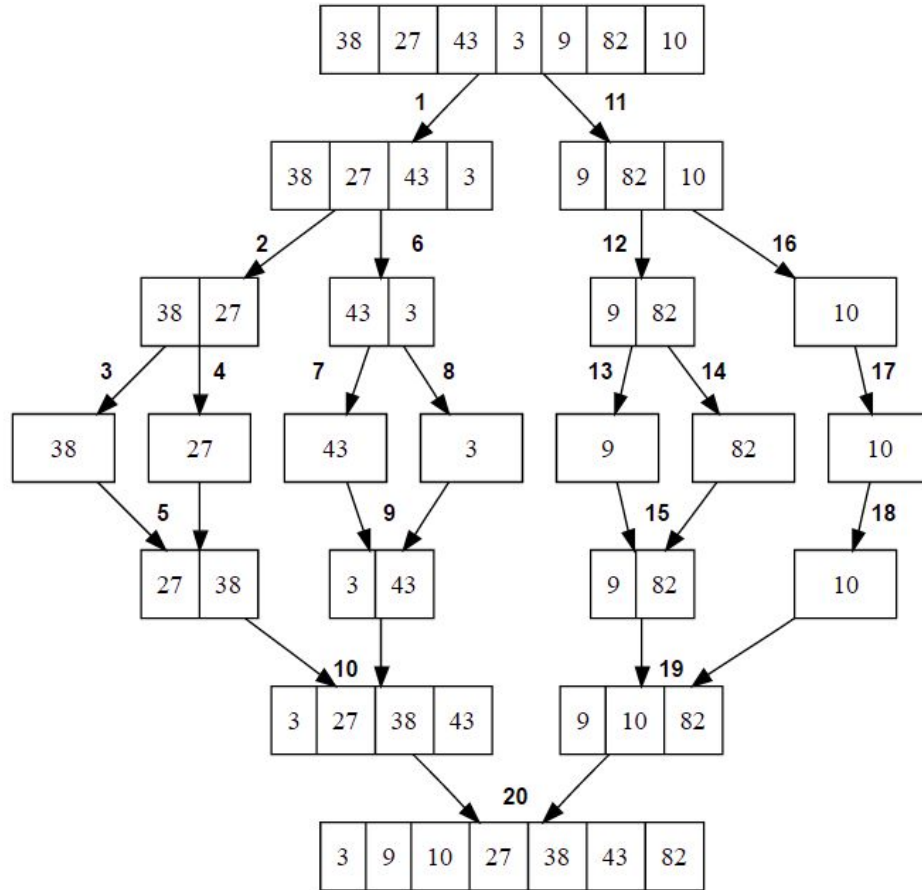
Merge Sort

The list of size n is divided into a max of $\log n$ parts, and the merging of all sublists into a single list takes $O(n)$ time. The worst, average and best cases have a run time of **$O(n \log n)$** .

This algorithm is efficient because it quickly sort large arrays.

The red section is where the recursive calls split into sub-arrays. The green section would be when the values return and merge





Top-down view of the recursive merge sort algorithm.

Merge Sort Pseudocode

```
int[] mergeSort(data){  
    if more than 1 element{  
        L = mergeSort left side  
        R = mergeSort right side  
        return merge(L,R)  
    }else{  
        return data  
    }  
}
```



Let's create the Merge Sort in Java

Save your code here: `classwork/xx_merge/Merge.java`

```
public static int[] mergeSort(int[] data){  
    }  
}
```

