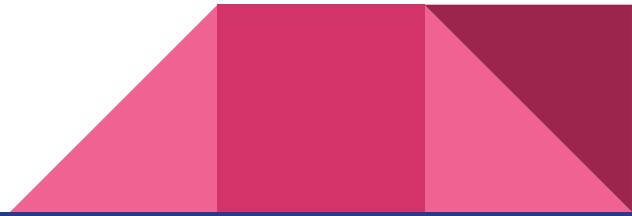
Merge Sort

Do now

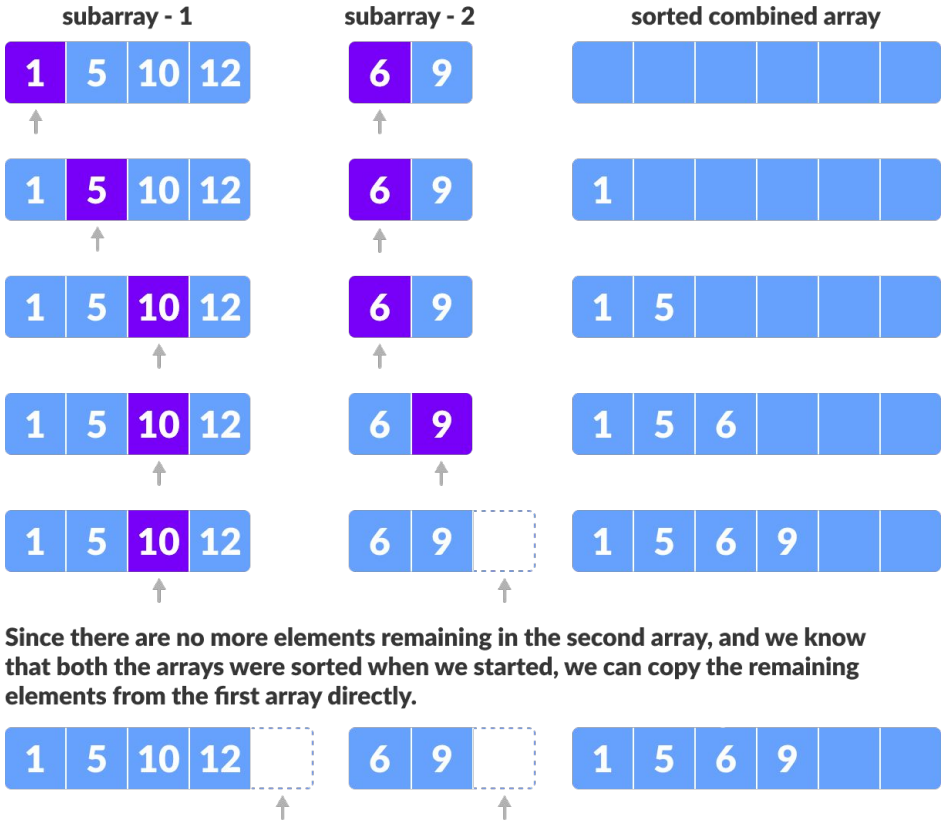
If we have 2 sorted arrays, how would you combine them to have only 1 sorted array?

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

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



Merging arrays



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){

}
```

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.

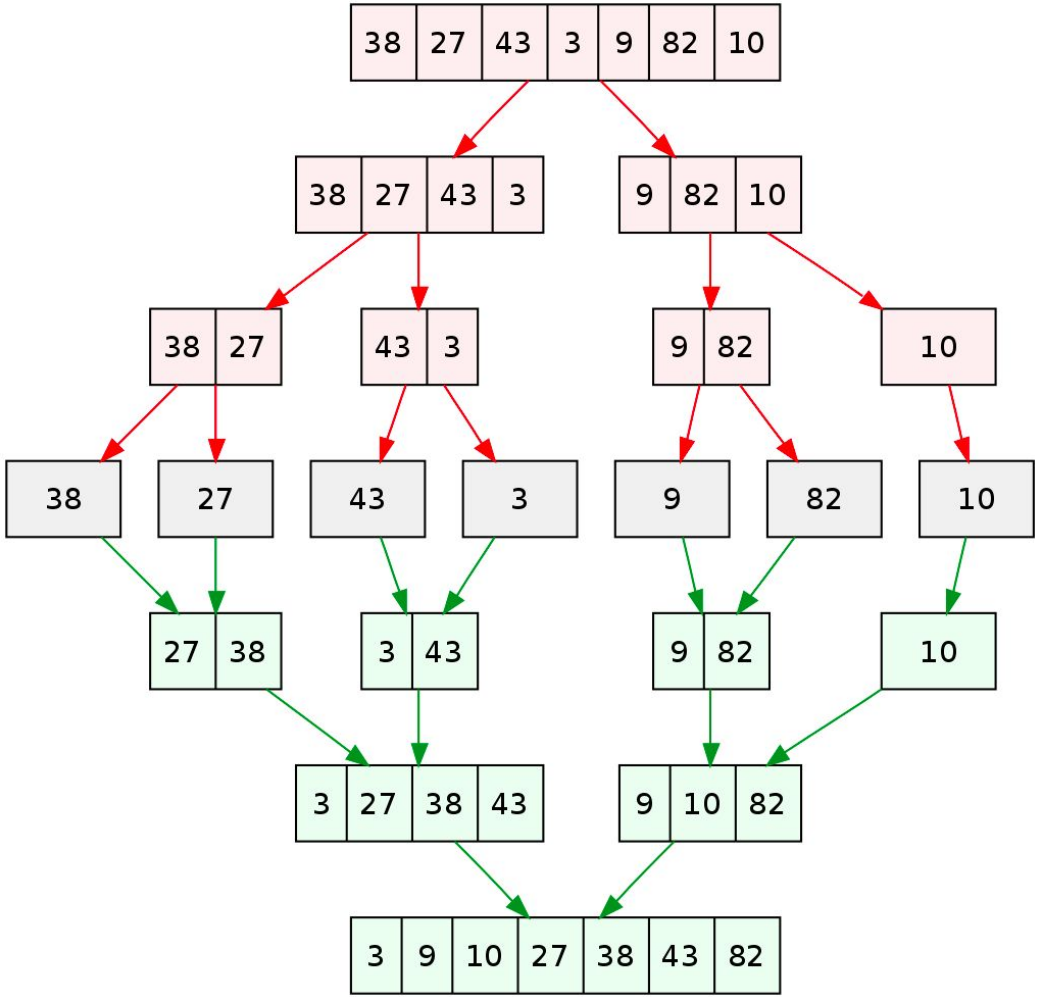
Recursive case: If the array has multiple elements, split the array into halves and recursively invoke the merge sort on each of the halves.

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

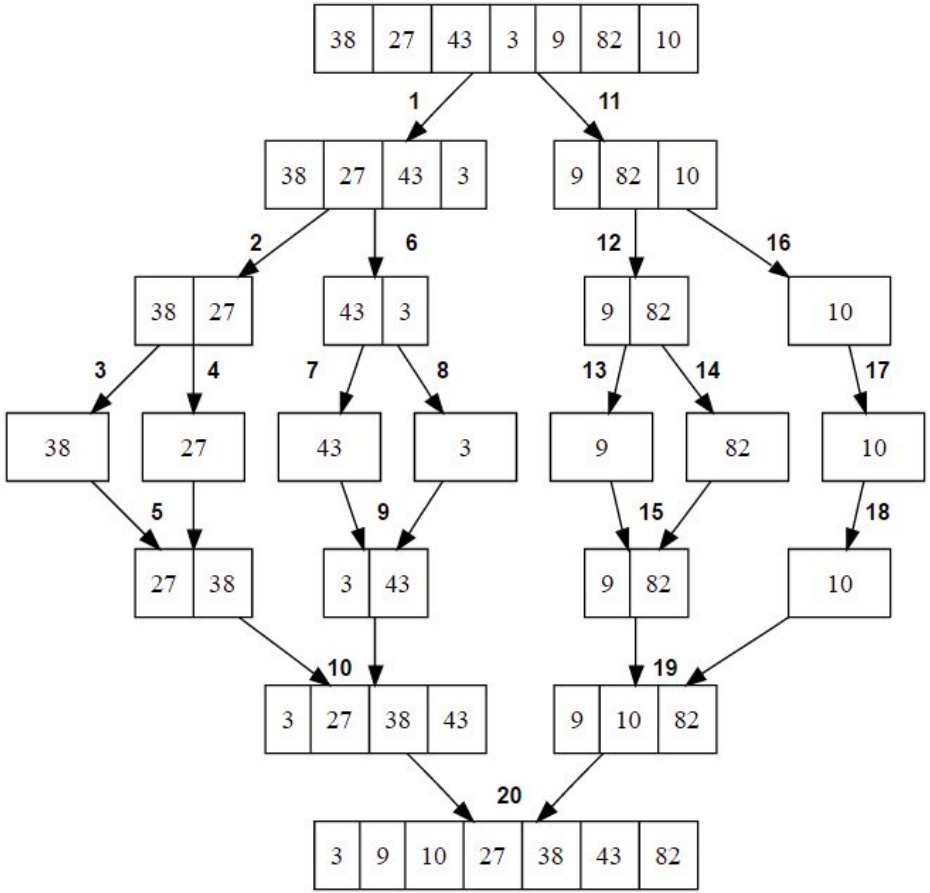


Merge Sort

The list of size n is divided into a max of logn 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 logn).**

This algorithm is efficient because it quickly sort large arrays.

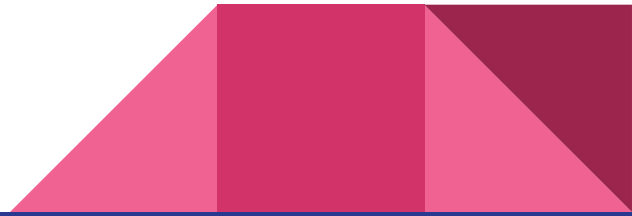
The red section is where the recursive calls split into sub-arrays. The green section would be when the values return and merge



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 implement the Merge Sort in Java

Lab is posted on our website: https://novillo-cs.github.io/apcsa/labs/

Method signature:

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

}
```

This is a **2-day project (3/3, 3/4)**

Today's homework: Dedicate 30 min to work on this lab at home.

Tomorrow: We will review any questions you might have and continue working on the code.