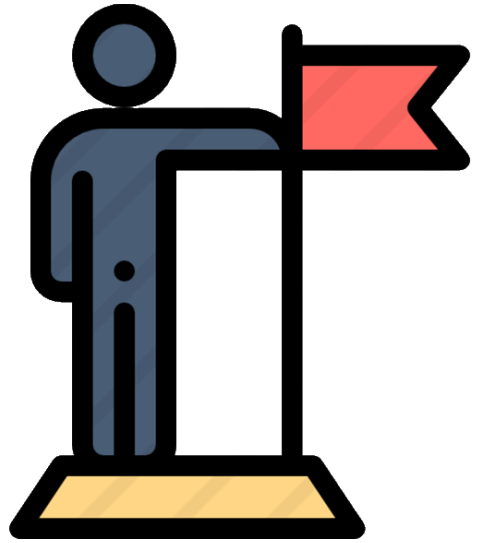
# Módulo 8: Recursión
# Parte 3
## Capítulo 11

# Merge Sort

Merge Sort es un algoritmo de ordenamiento más eficiente que los otros algoritmos de ordenamiento que hemos visto anteriormente.

Es un algoritmo recursivo que utiliza un patrón de diseño de tipo “Divide and Conquer”.



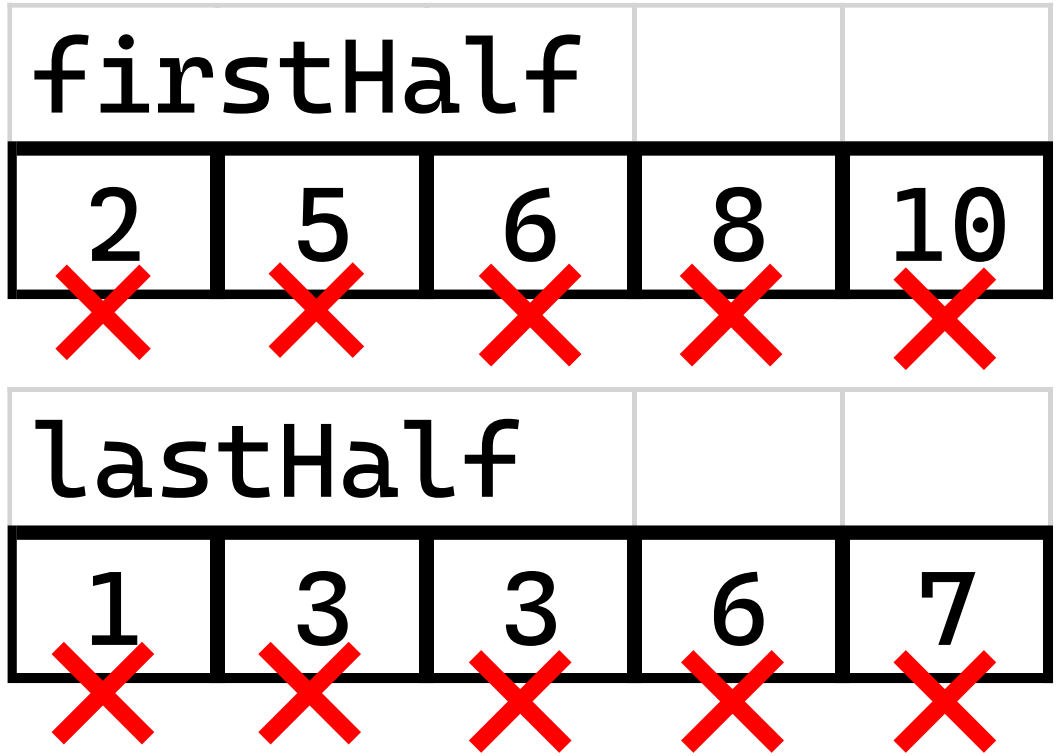
# Método divide( )

Diseña un método que permita partir un arreglo a la mitad, retornando las dos mitades en arreglos distintos.

```
private static void divide(int[] from, int[] firstHalf, int[] lastHalf) {
  //copy first half of array
  for(int i=0; i<firstHalf.length; i++) {
    firstHalf[i] = from[i];
  }
  //copy second half of array
  for(int i=0; i<lastHalf.length; i++) {
    lastHalf[i] = from[i+firstHalf.length];
  }
}
```

# Método merge( )

Diseña un método que permita partir un arreglo a la mitad, retornando las dos mitades en arreglos distintos.




| 1 | 2 | 3 | 3 |
|---|---|---|---|

| 5 | 6 | 6 | 7 |
|---|---|---|---|

| 8 | 10 |
|---|---|

```
private static void merge(int[] newArray, int[] firstHalf, int[] lastHalf) {
  int firstHalfIndex = 0, lastHalfIndex = 0, newArrayIndex = 0;

  //Compare and copy the smallest element
  while (firstHalfIndex < firstHalf.length && lastHalfIndex < lastHalf.length) {
    if (firstHalf[firstHalfIndex] < lastHalf[lastHalfIndex]) {
      newArray[newArrayIndex] = firstHalf[firstHalfIndex];
      firstHalfIndex++;
    } else {
      newArray[newArrayIndex] = lastHalf[lastHalfIndex];
      lastHalfIndex++;
    }
    newArrayIndex++;
  }
  //Copy remaining objects from firstHalf
  while(firstHalfIndex < firstHalf.length) {
    newArray[newArrayIndex++] = firstHalf[firstHalfIndex++];
  }
  //Copy remaining objects from lastHalf
  while(lastHalfIndex < lastHalf.length) {
    newArray[newArrayIndex++] = lastHalf[lastHalfIndex++];
  }
}
```

# Merge Sort

El Merge Sort está compuesto por 2 pasos:

1. Divide
2. Merge

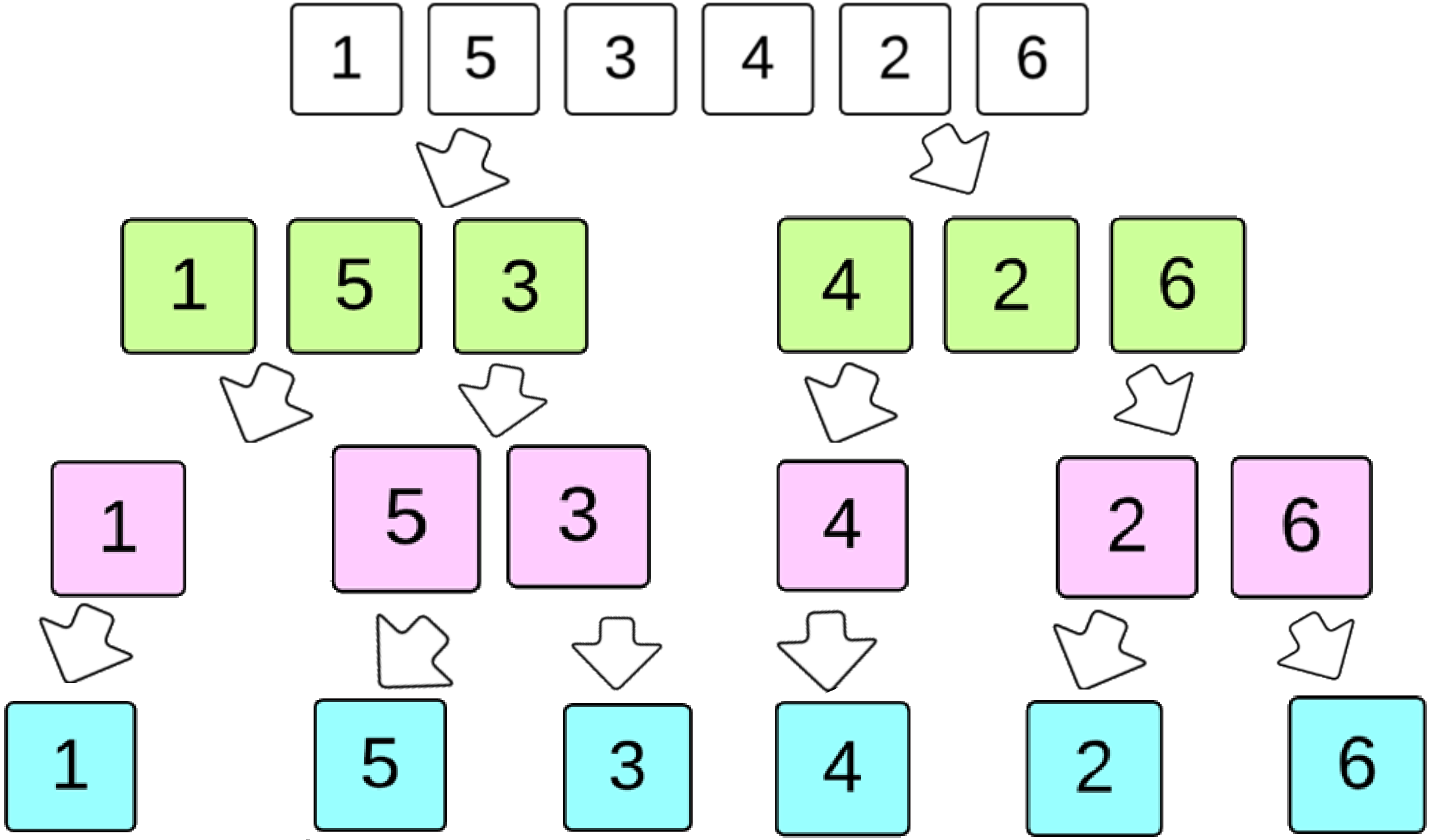
# Merge Sort

## Caso base

1. El tamaño del arreglo `data` es menor o igual a 1. (El arreglo está ordenado).

## Caso Recursivo

2. Copiar la primera mitad del arreglo `data` a `firstHalf`.
3. Copiar el resto de los elementos de `data` a `lastHalf`.
4. Ordenar `firstHalf` usando una llamada recursiva a `mergeSort()`.
5. Ordenar `lastHalf` usando una llamada recursiva a `mergeSort()`.
6. Unir `firstHalf` y `lastHalf`.


1 5 3 4 2 6
1 5 3
4 2 6
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5 3
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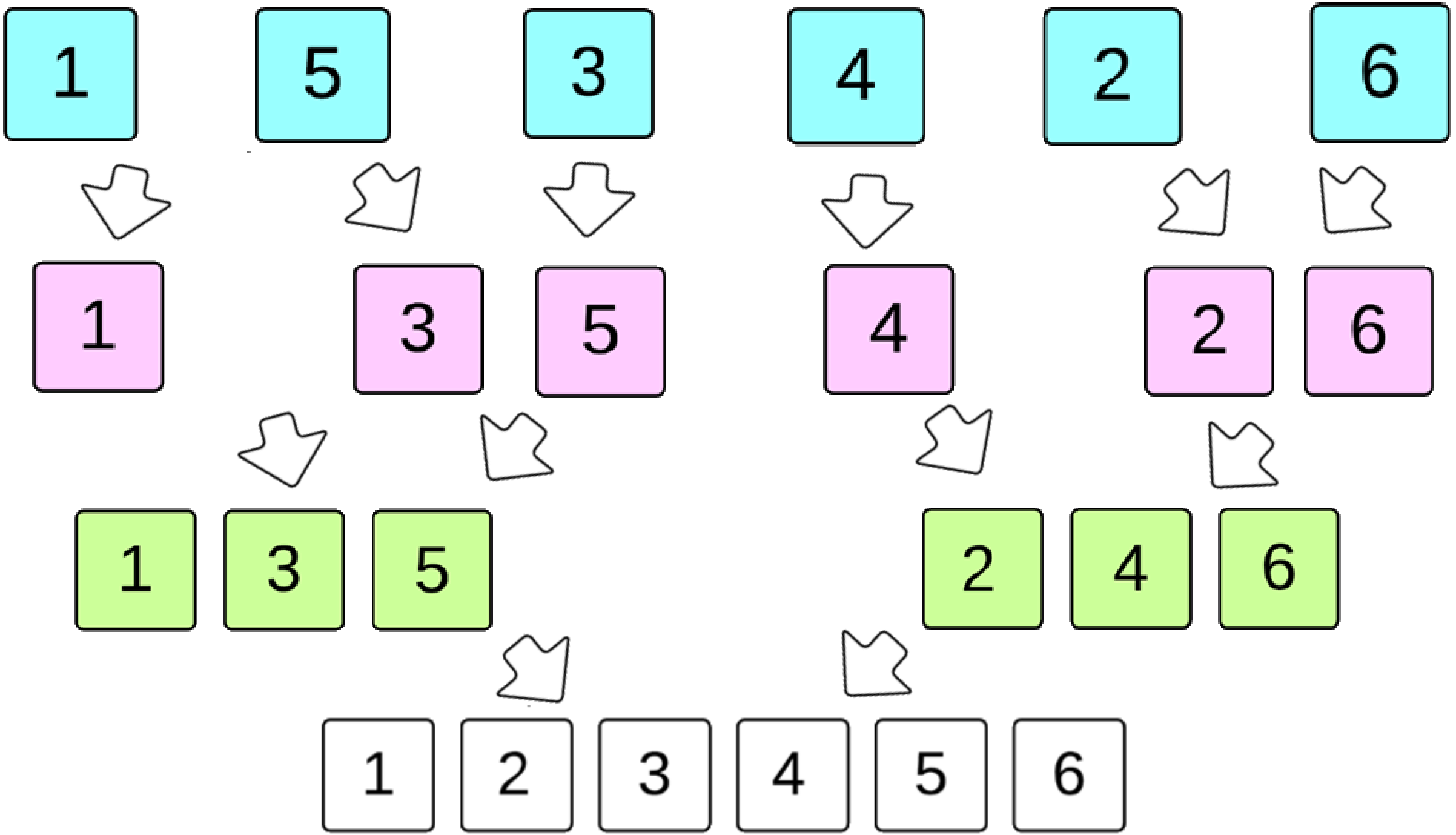
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6

# Merge Sort

https://www.hackerearth.com/practice/algorithms/sorting/merge-sort/visualize/

# Merge Sort

```
public static void mergeSort(int[] data) {
  //base case -> 1 element array is always sorted
  if (data.length <= 1)
    return;

  //divide
  int[] firstHalf = new int[data.length / 2];
  int[] lastHalf = new int[data.length - firstHalf.length];
  divide(data, firstHalf, lastHalf);

  //recursive call -> sort halves
  mergeSort(firstHalf);
  mergeSort(lastHalf);

  //merge two halves
  merge(data, firstHalf, lastHalf);
}
```

# Merge Sort

Ordena los siguientes arreglos utilizando el algoritmo merge sort.

| -5 | 5 | 10 | 15 | -10 |
|---|---|---|---|---|

| 77 | 8 | 5 | 63 | 1 | 2 | 6 | 5 | 4 | 8 |
|---|---|---|---|---|---|---|---|---|---|