Merge Sort ①

Merge sort is a sorting algorithm that uses the idea of divide and conquer approach.

① MERGE-SORT (A, p, r)

1) if $p < r$
2)   then $q \leftarrow \lfloor (p + r)/2 \rfloor$
3)   MERGE-SORT (A, p, q)
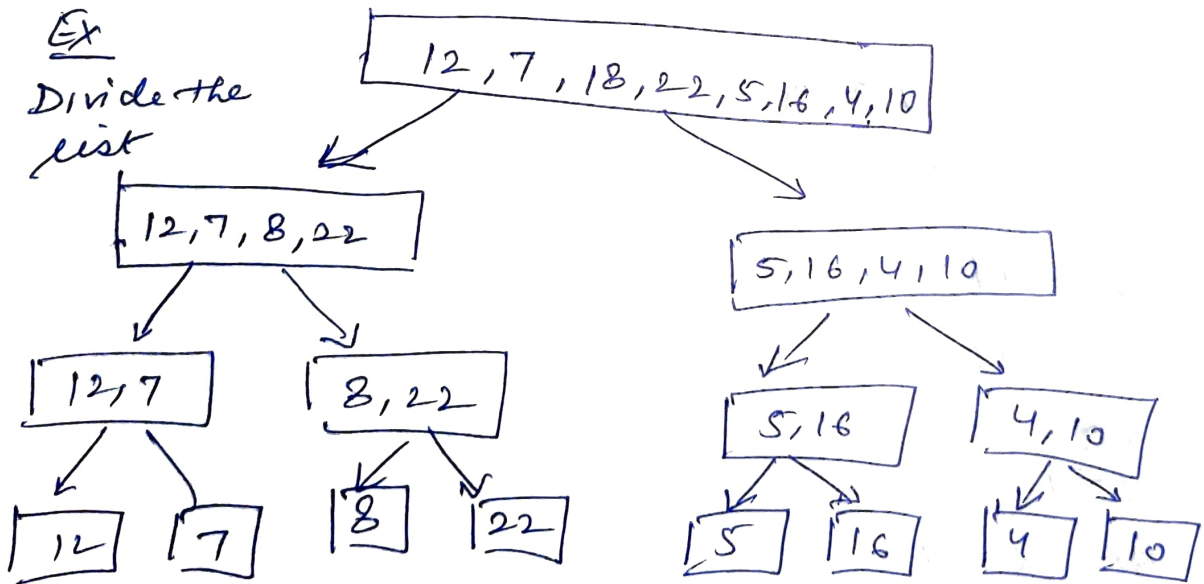4)   MERGE-SORT (A, q+1, r)
5)   MERGE (A, p, q, r)

② MERGE (A, p, q, r)

1) $n_1 \leftarrow q - p + 1$
2) $n_2 \leftarrow r - q$
3)   create arrays $L[1 .. n_1 + 1]$ and $R[1 .. n_2 + 1]$
4)   for $i \leftarrow 1$ to n_1
5)   do $L[i] \leftarrow A[p + i - 1]$
6)   for $j \leftarrow 1$ to n_2
7)   do $R[j] \leftarrow A[q + j]$
8) $L[n_1 + 1] \leftarrow \infty$
9) $R[n_2 + 1] \leftarrow \infty$
10) $i \leftarrow 1$
11) $j \leftarrow 1$
12)   for $k \leftarrow p$ to r
13)   do if $L[i] \leq R[j]$
14)   then $A[k] \leftarrow L[i]$
15) $i \leftarrow i + 1$

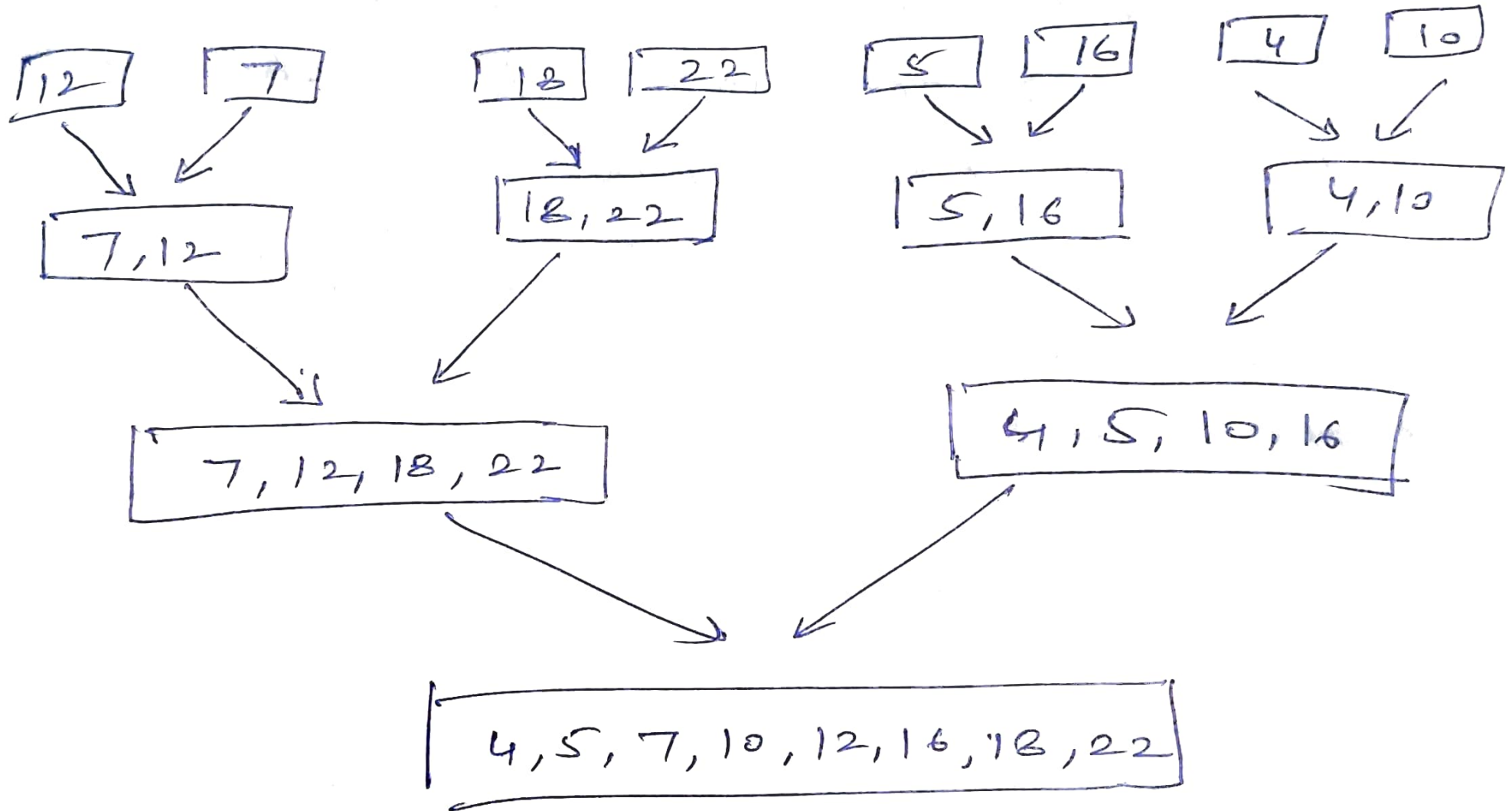16)   else A[K J ← R[j]

17)   J ← j+1

This is a good example of external sorting when
files are sorted using the external devices like
disks or tapes.

Merge sort algorithm is based on divide and
conquer strategy same as Quick sort. The
list of N elements is first divided into two
sublists of N/2 elements. This phase is called
divide phase. Then each half is sorted indep-
-endently; this phase is called the conquer phase
The two sorted halves are merged to a sorted
sequence. The key operation of merge sort is
merging.

Ex
Divide the
list

12,7,18,22,5,16,4,10

12,7,8,22

12,7   8,22

12   7   8   22

5,16,4,10

5,16   4,10

5   16   4   10

Step 2: Merge the adjacent list:

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[12]    [7]          [18]    [22]        [5]    [16]         [4]    [10]
    ↓                    ↓                   ↓                   ↓
  [7,12]               [18,22]             [5,16]             [4,10]
       ↓          ↓                              ↓         ↓
      [7, 12, 18, 22]                          [4, 5, 10, 16]
                  ↓                ↓
              [4, 5, 7, 10, 12, 16, 18, 22]
```

Complexity :- $O(n \log n)$