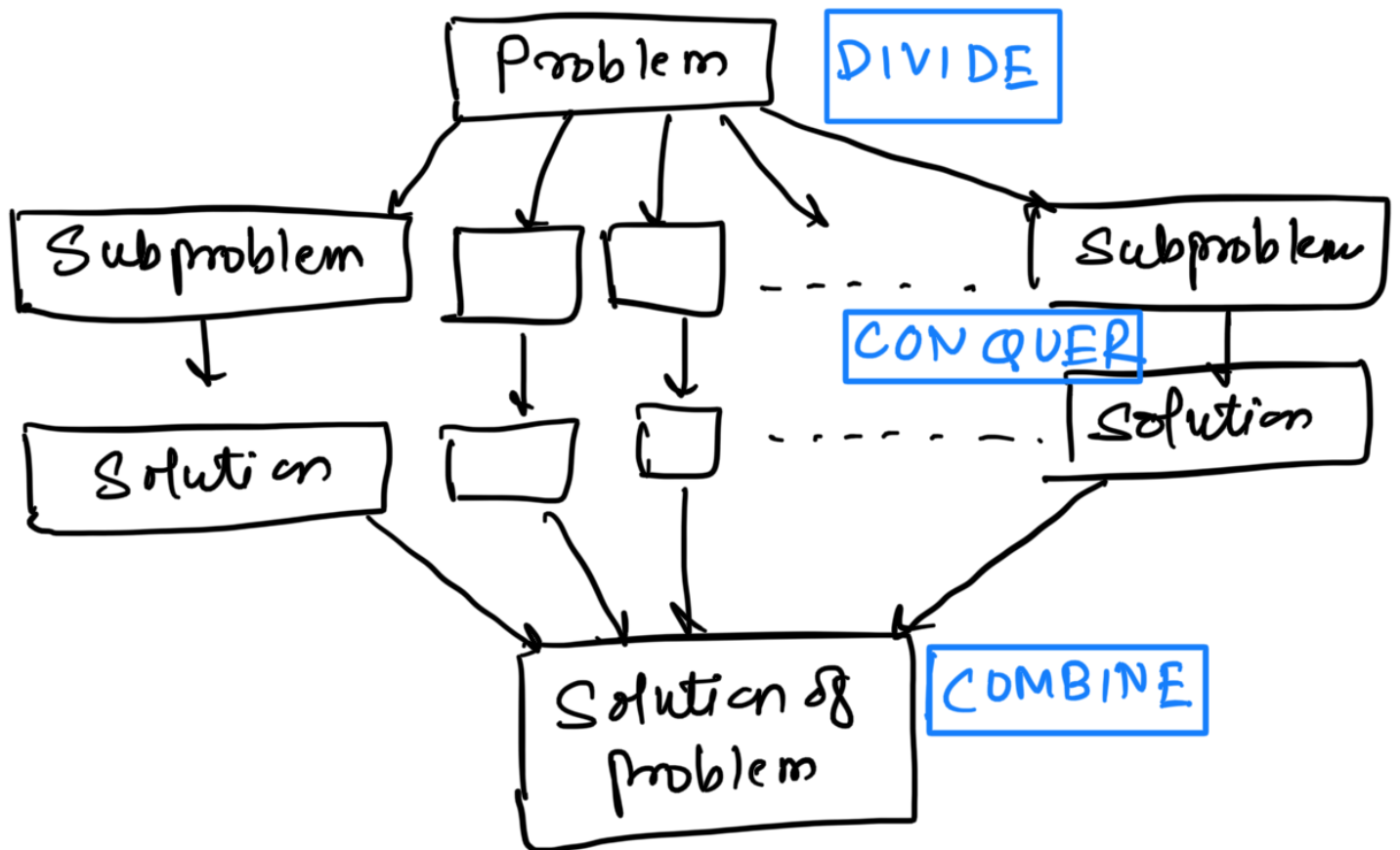


- Sorting
- ① Merge sort
 - ② Quick sort
- } Divide & Conquer

Divide & Conquer



- breaks a problem into subproblem

↓
 Same as original ^{subproblem} problem
 ↓
 recursive ^{solⁿ for subproblem} method
 ↓
 Combine all the solution

Divided into 3 parts

1. Divide the problem — dividing it into number of subproblems that are smaller instances of the same problem.

2. Conquer the subproblem — by solving them recursively (base case is $n=1$)

recursion: (small problem \rightarrow base case)

Terminate

3. Combine the solution - combined solution of subproblems will be the solution for the original problem.

Merge Sort

- technique divide & Conquer

└ full problem: sort an array

└ sub problems: sort a sub array



$n=9$ \uparrow l

left

right

\uparrow r

$$\text{mid} = \frac{l+r}{2} = \frac{0+9}{2} = \frac{9}{2} = 4.5 \quad \left\lfloor \frac{l+r}{2} \right\rfloor \approx 4$$



subarray 1
 l

mid

r



subarray 2
 l

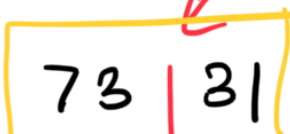
r



sub 1
 l r



sub 2
 l r

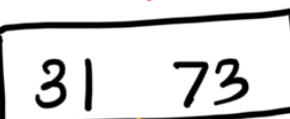
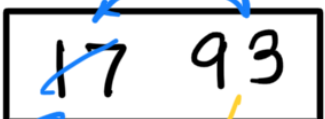
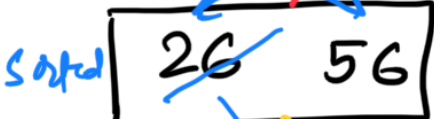
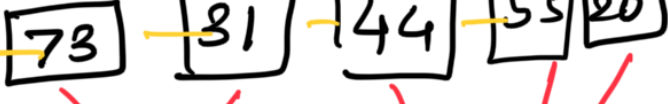


l r



l r

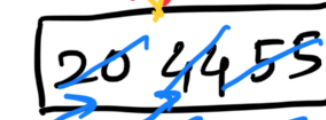
DIVIDE

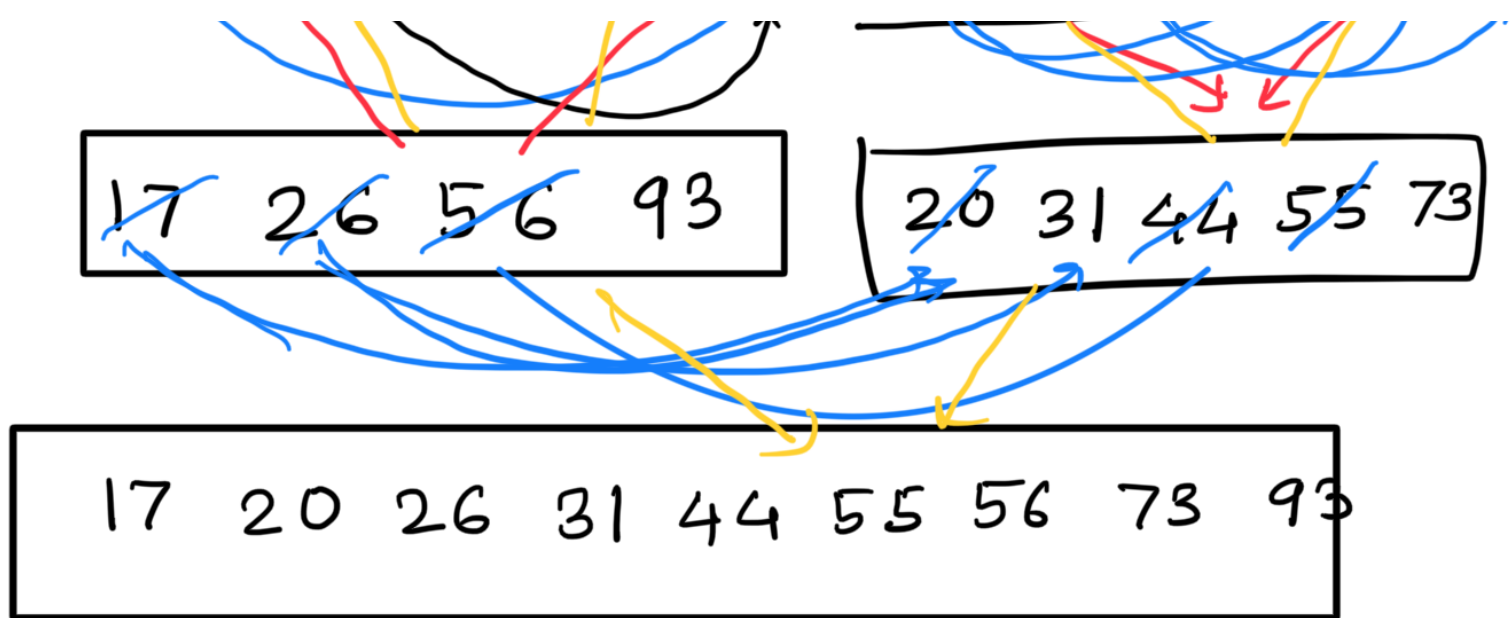


subsoln 1

subsoln 2

COMBINE





DIVIDE - CONQUER - COMBINE

Algorithm

merge-sort(A, l, r)

{ if $l < r$

mid $\rightarrow \lfloor (l+r)/2 \rfloor$ — ①

Left \rightarrow merge-sort(A, l, mid) — ②

Right \rightarrow merge-sort($A, mid+1, r$) — ③
}

