

1) searching: 1) linear search

1, 2, 0, -1, -9, 99

2) Binary Search

a) sorted list

key      1, 2, 0, 45, 99  
key = mid → find      mid

key > mid → low = mid + 1

key < mid → high = mid - 1

2) sorting

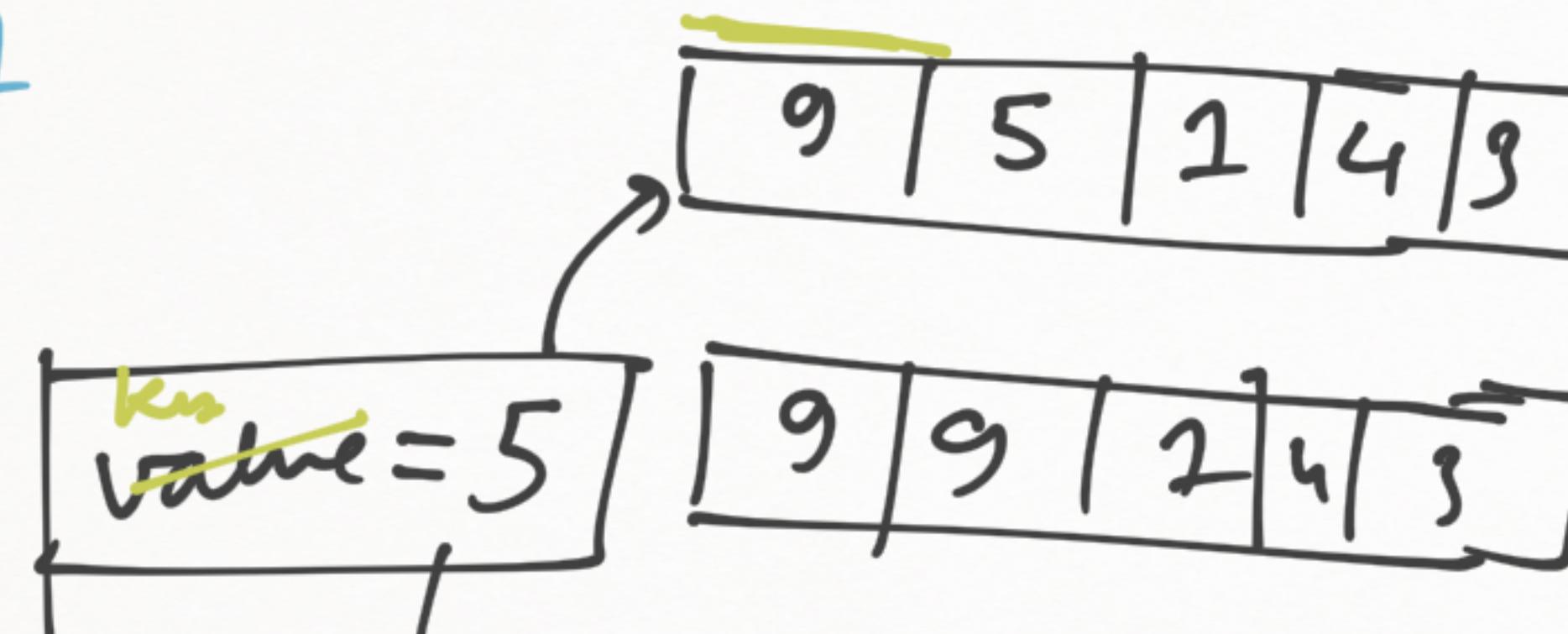
i) Bubble Sort

2, 7, 15, 4, -1, 0, 99

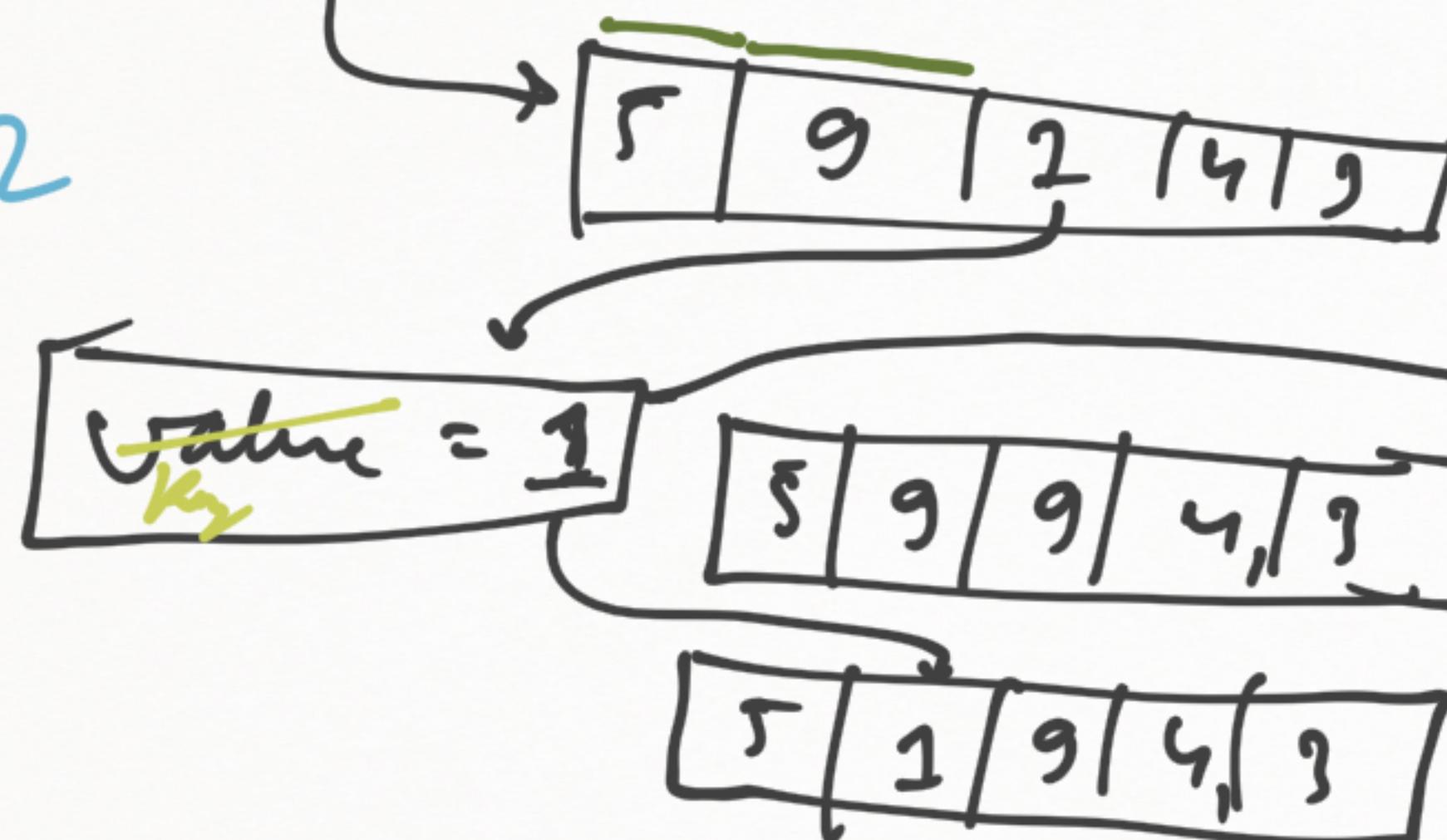
compare and swap

## Insertion Sort

Step 1

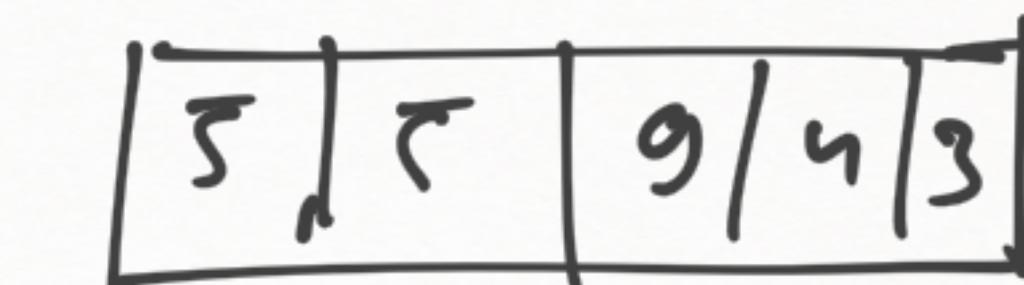


Step 2

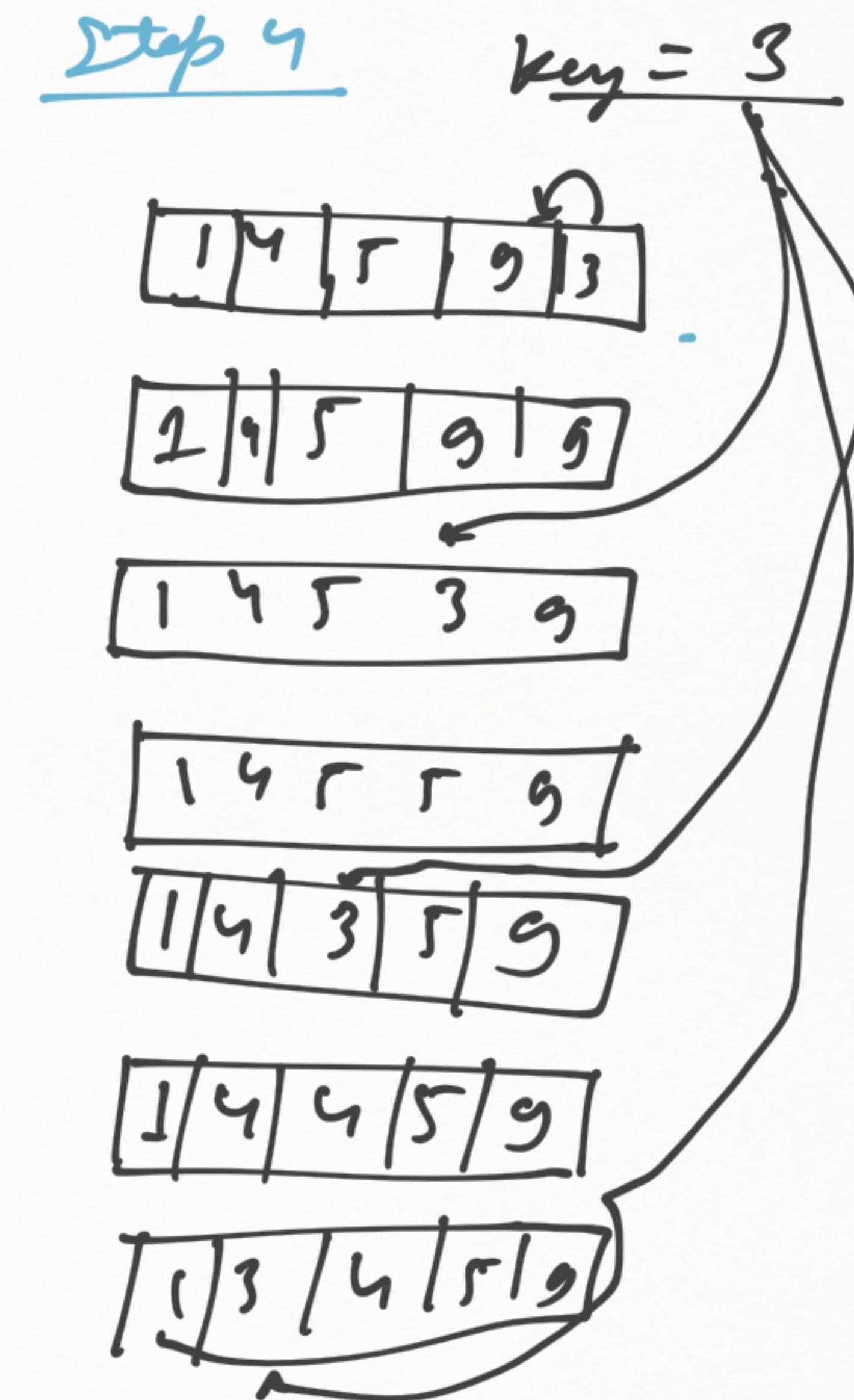
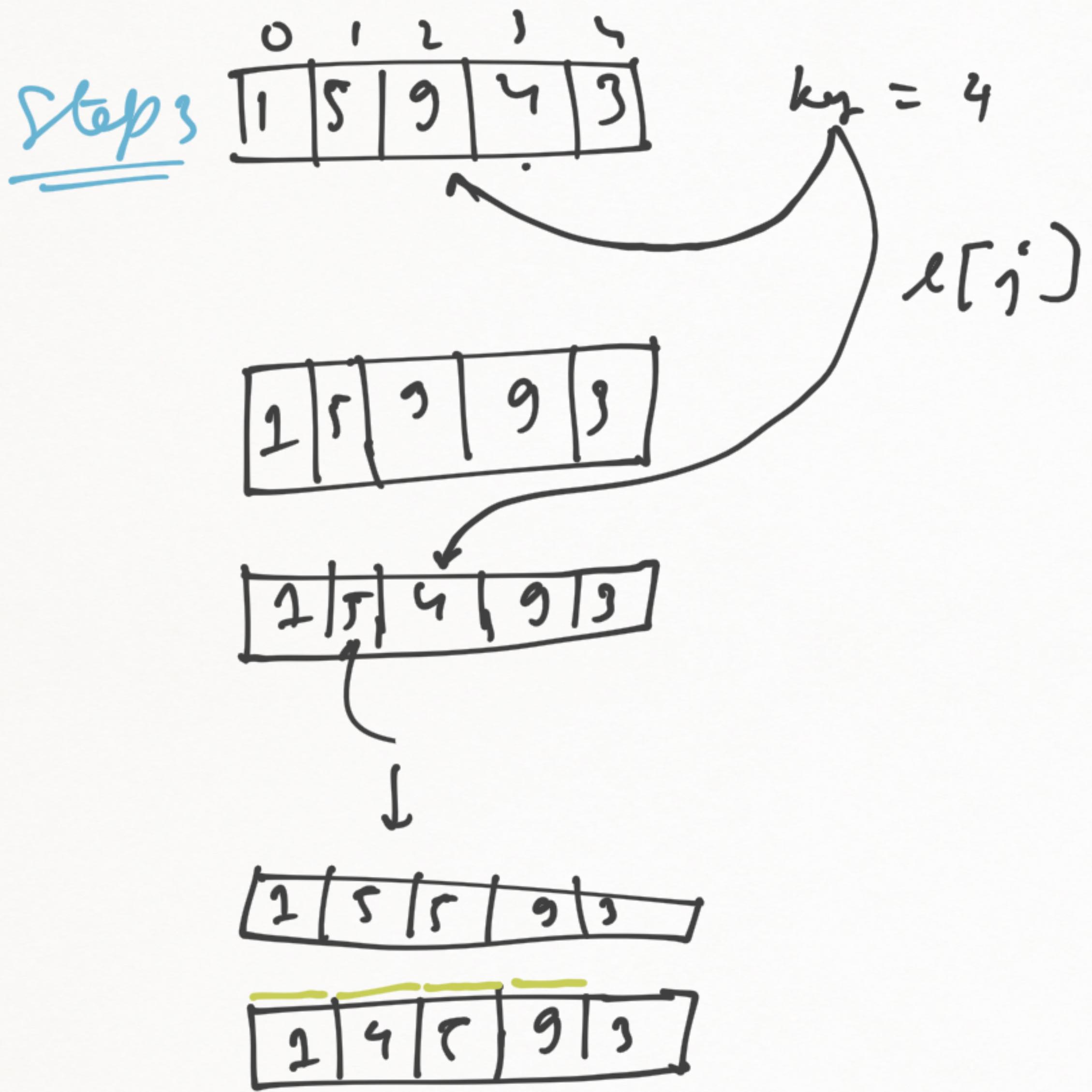


Assume

i) First element is sorted



key = 4



## Pseudocode



for  $i = 1$  to  $\text{length}(\text{list}) - 1$

    key =  $\text{list}[i]$

$j = i - 1 \rightarrow i-1 \rightarrow 0 \quad i > -1$

    while  $j \geq 0$  and  $\text{list}[j] > \text{key}$

$\text{list}[j+1] = \text{list}[j]$

$j = j - 1$

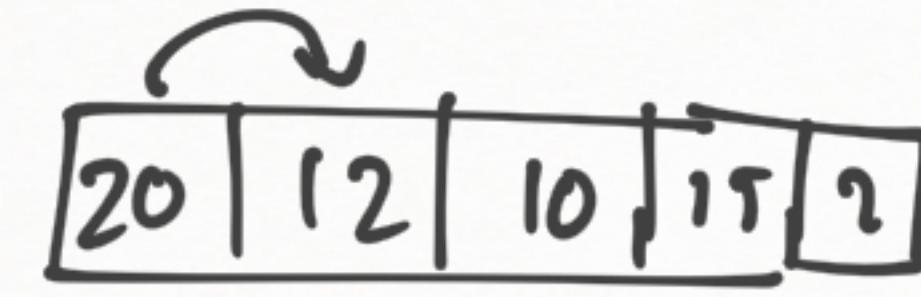
$\text{list}[j+1] = \text{key}$ .

|                      |     |
|----------------------|-----|
| $j$                  | key |
| $\cancel{\emptyset}$ | -1  |
| -1                   |     |

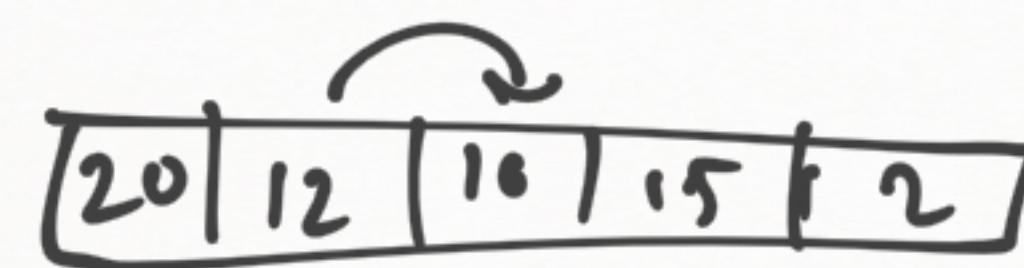
Selection Sort

$$\underline{\min = 20}$$

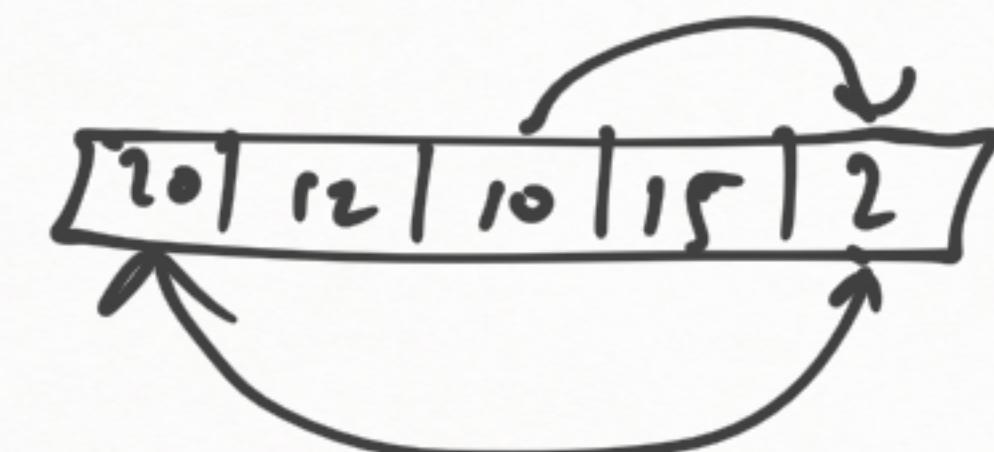
$$\min(1)$$



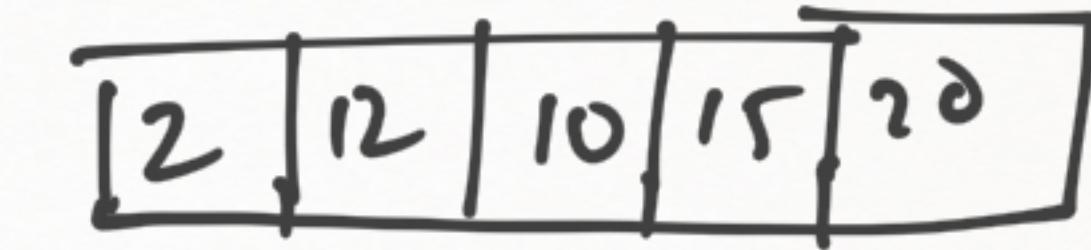
$$\min = 12$$



$$\min = 10$$



$$\min = 2$$



|   |    |    |    |    |
|---|----|----|----|----|
| 2 | 12 | 10 | 15 | 20 |
| 1 | 2  |    |    |    |

$\min = 10$

|   |    |    |    |    |
|---|----|----|----|----|
| 2 | 12 | 10 | 15 | 20 |
|   |    |    |    |    |

|   |    |    |    |    |
|---|----|----|----|----|
| 2 | 10 | 12 | 15 | 20 |
|   |    |    |    |    |

$\min = 12$

## Pseudo code

- repeat  $(size - 1)$  times
  - set the first unsorted element as minimum
  - loop over the unsorted elements
  - check if element < current min
  - set element as new minimum
  - swap minimum with first unsorted position
- end.

|   |    |    |    |    |
|---|----|----|----|----|
| 2 | 10 | 12 | 15 | 20 |
|   |    |    |    |    |

Recursion

$$5! = \underline{5 \times 4 \times 3 \times 2 \times 1}$$

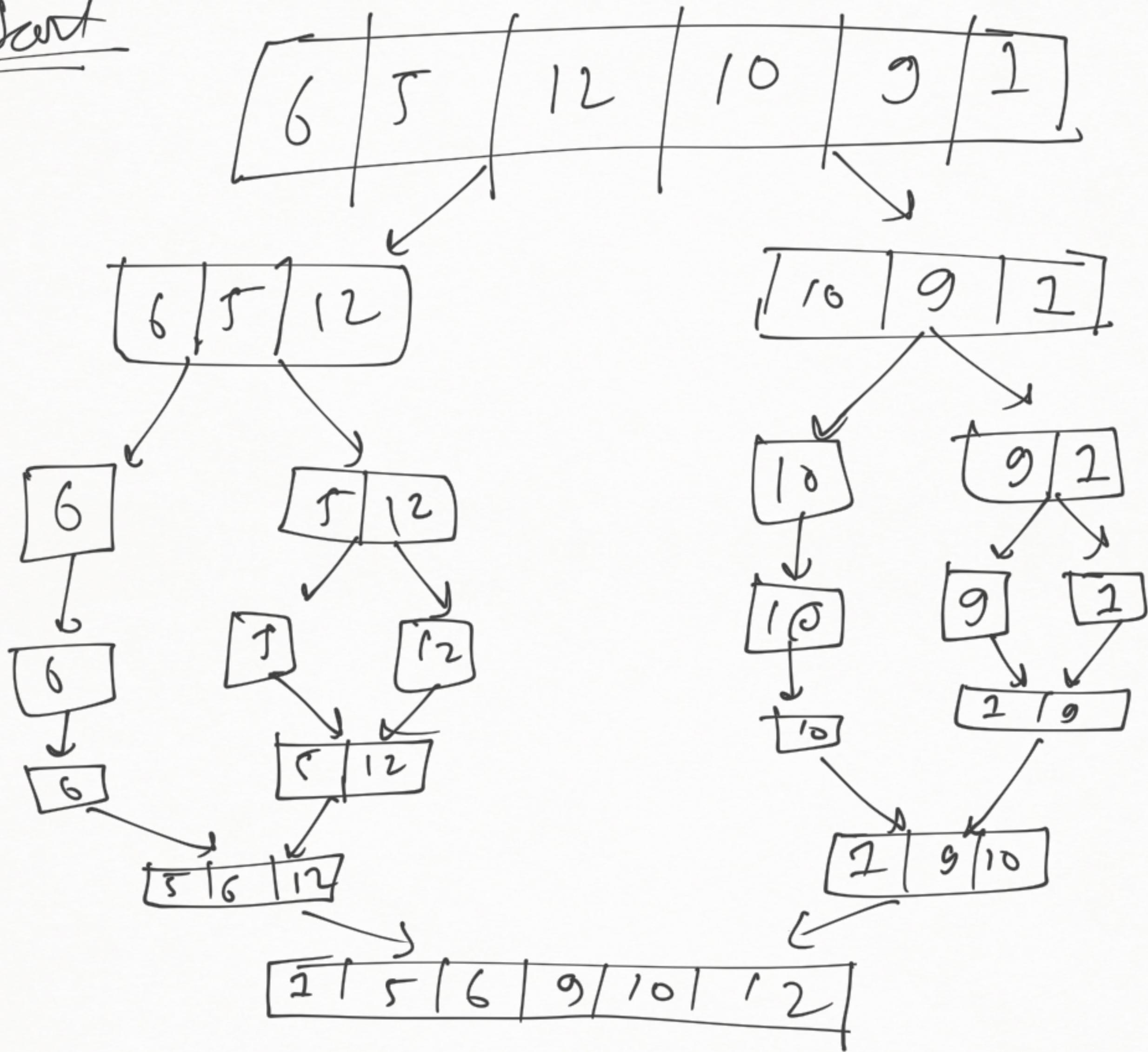
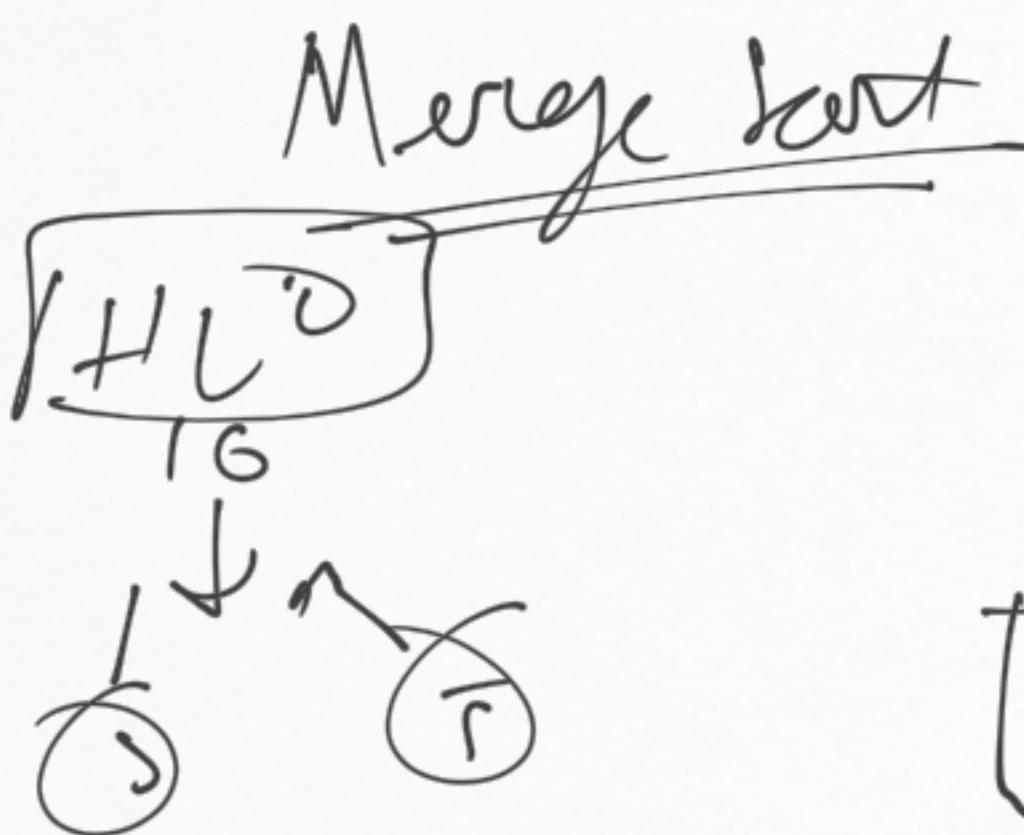
$$\text{fact}(n) = n * \text{fact}(n-1),$$

for  $n > 0$

$$(n-1) \text{ fact}(n-2)$$

$$(n-2) \text{ fact}(n-3) \rightarrow (n-3) \text{ fact}(n-4)$$

$$\begin{matrix} \\ \vdots \\ 3 \times 2 \times 1 \cdots 0 \end{matrix} \dots \dots \dots \infty$$



|    |   |    |   |    |    |    |   |    |    |
|----|---|----|---|----|----|----|---|----|----|
| 11 | 9 | 21 | 8 | 17 | 19 | 13 | 1 | 24 | 12 |
|----|---|----|---|----|----|----|---|----|----|

max = 24



0-5



5-10



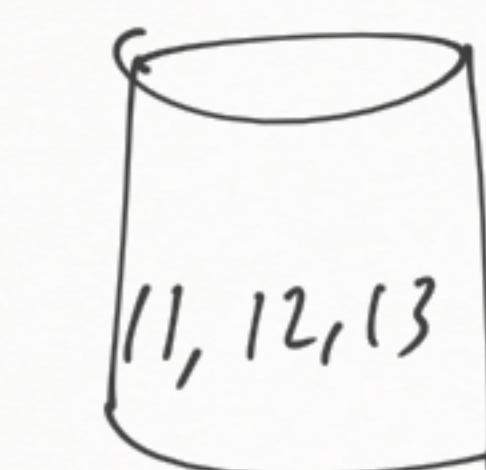
10-15



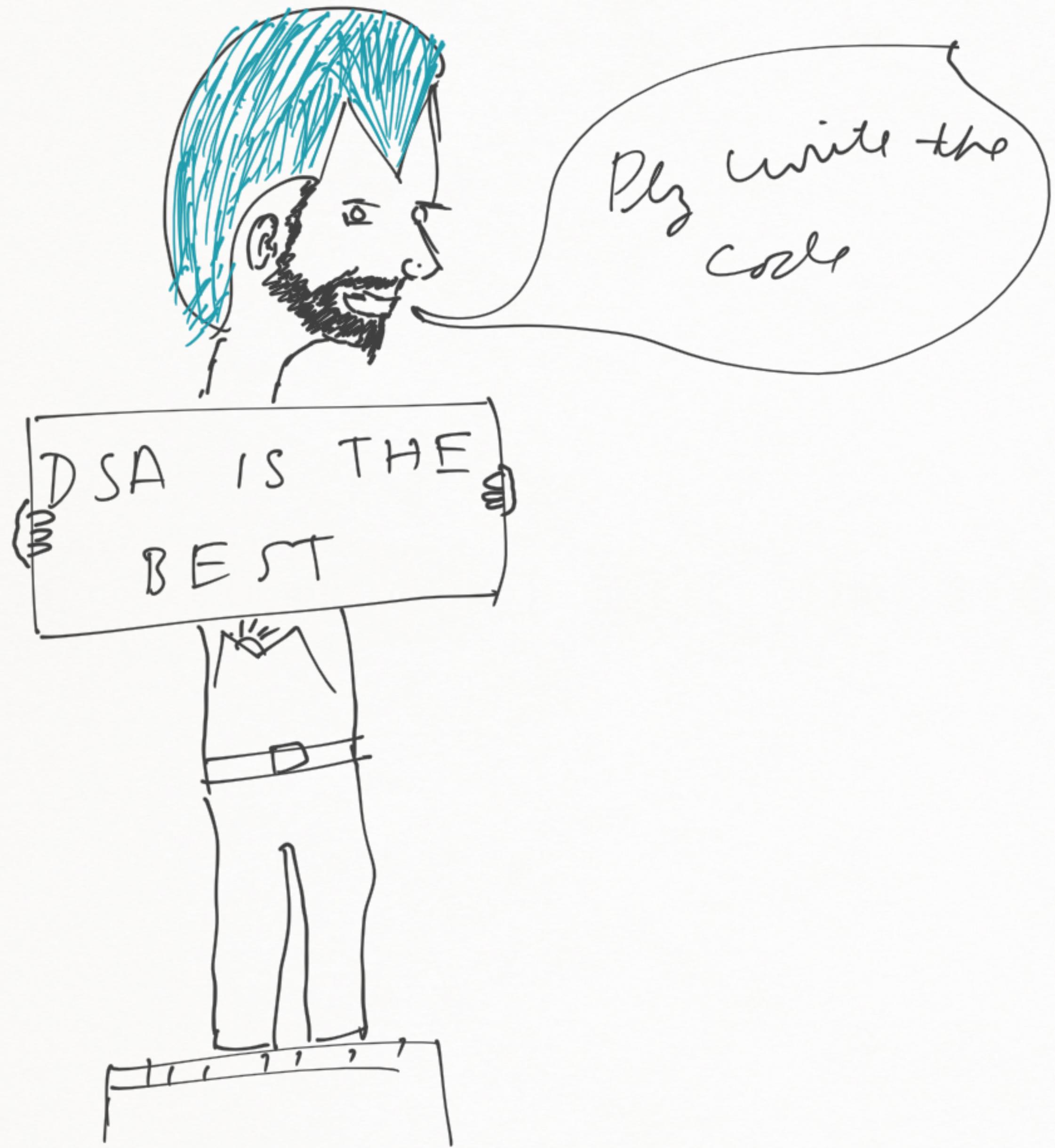
15-20



20-25



|   |   |   |    |    |    |    |    |    |    |
|---|---|---|----|----|----|----|----|----|----|
| 1 | 8 | 9 | 11 | 12 | 13 | 17 | 19 | 21 | 24 |
|---|---|---|----|----|----|----|----|----|----|



Worst case :  $O(n^2)$