

Quick sort

	0	1	2	3	4	5	6	7	8	9
		16	8	12	15	6	3	9	5	8
	10									
	↓	→								← ↓

Pivot element i

i greater than pivot

j less than left side

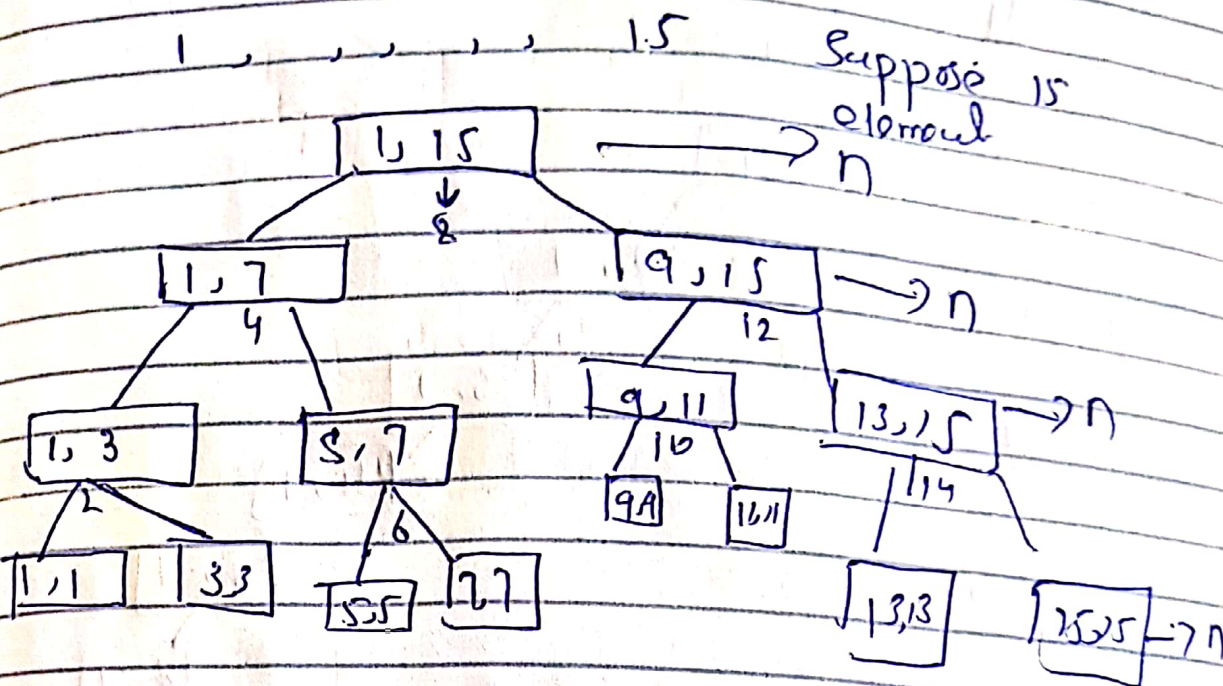
10	16	8	12	15	6	3	9	5	8
	i							j	
10	5	8	12	15	6	3	9	16	8
	i		i				j	j	
10	5	8	9	15	6	3	12	16	8
			i	i		j	j	j	
10	5	8	9	3	6	15	12	16	8
			i	i		j	j	j	
10	5	8	9	3	6	15	12	16	8
				i	j	i			

because i cross the j each other
that we cannot swap the values and
we reached the new pivot element

6	5	8	9	3	10	15	12	16	8
					j	j			

Codes on the slide

Time Analysis is



$$\frac{n}{2} = 1$$

$$\frac{n}{2} = 2$$

$$\frac{n}{2} = 4$$

$$\frac{n}{2} = 8$$

$$\frac{n}{2} = 16$$

$$\frac{n}{2^k} = 1$$

$$n = 2^k$$

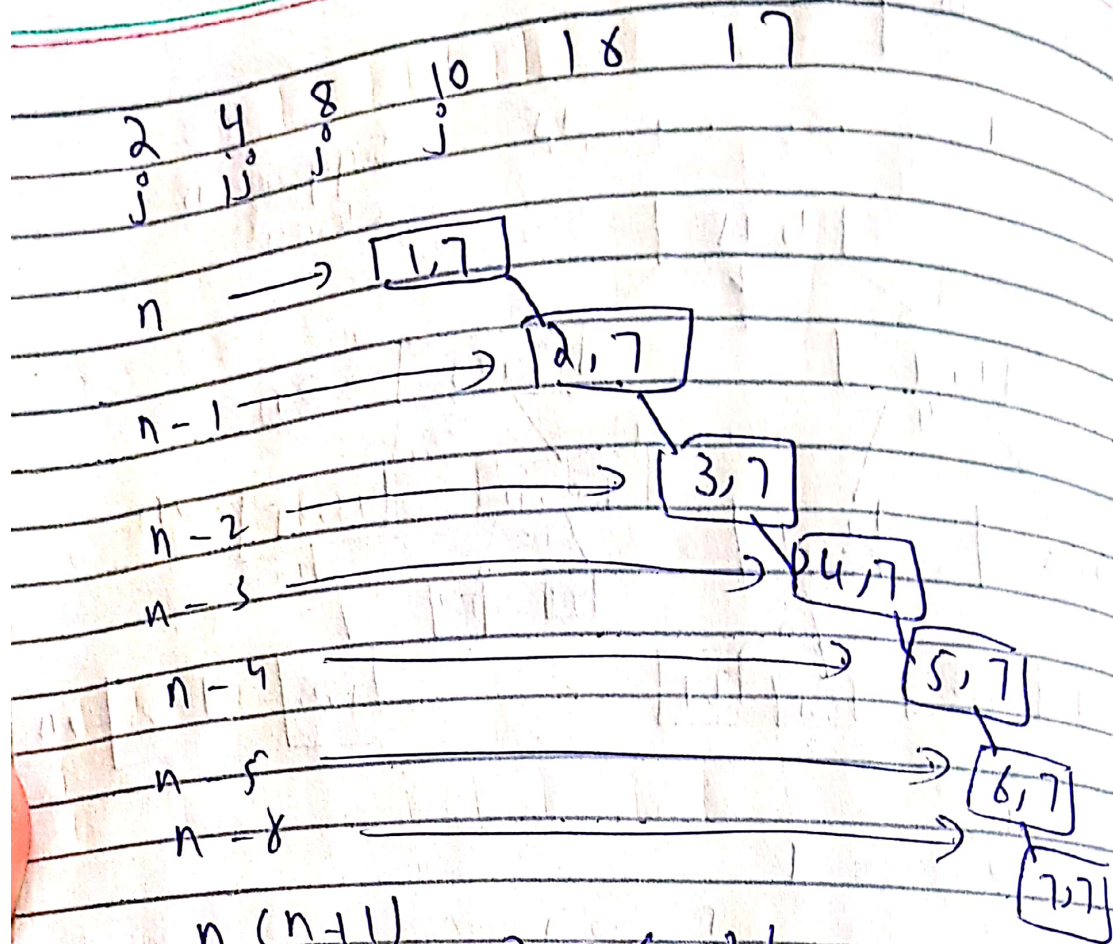
$$n = 2^k$$

$$k = \log_2 n$$

$O(n \log n) \rightarrow$ If the partition always in the middle
 Best case $\rightarrow O(n \log n)$ that is best time

Worst case

\hookrightarrow If the partition is happen at the beginning or ending



$$\frac{n(n+1)}{2} \Rightarrow O(n^2)$$

\rightarrow Worst case

Worst case most probably happen when data is already sorted, then partition would happen beginning or ending then the running time $O(n^2)$

How to avoid this

1 \rightarrow select Middle element as pivot

2 \rightarrow Select Random element as pivot

$O(n^2) \rightarrow$ worst case

$O(n \log n) \rightarrow$ best case