

CLASS ASSIGNMENT

Introduction to Algorithm
CSE-411

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Quick sort applies divide & conquer paradigm.

Algorithm 1: QUICKSORT ALGORITHM:

```
QUICKSORT(A,p,r)
if p > r then
    q= PARTITION(A,p,r)
    QUICKSORT(A,p,q-1)
    QUICKSORT(A,q+1,r)
end if
```

Algorithm 2: Partition algorithm:

```
PARTITION(A,p,r)
x=A[r]
i=p-1
for j=p to r-1 do
    if A[j] ≤ x then
        i=i+1
    end if
    exchange A[i] with A[j]
end for
exchange A[i+1] with A[r]
return i+1
```

pen & paper description of quick sort

5	2	4	6	1	3
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STEP	VALUES	TRUE/FALSE	AFTER THE OPERATION ARRAY WILL BE :	DISCUSSION
1.QUICKSORT(A,p,r)	p=1 r=6	2. p < r true	5 2 4 6 1 3	
3.q=PARTITION(A,p,r)	p=1 r=6			
1. x=A[6]	x=3			
2. i=p-1	i=0			
3.for(j=p to r-1)	j=1: if(A[1] <= x) if(5 <= 3)	false		
	j=2: if(A[2]<=x) if(2<=3) i=i+1 i=1 swap(A[i],A[j]) swap(A[1],A[2])	true	2 5 4 6 1 3	
	j=3 : if(A[3]<=x) if(4<=3)	false		
	j=4: if(A[4]<=x) if(6<=3)	false		
	j=5: if(A[5]<=x) if(1<=3) i=i+1 i=2 swap(A[2],A[5])	true	2 1 4 6 5 3	
swap(A[i+1] ,A[r])	swap(A[3],A[6])		2 1 3 6 5 4	

Table 1:

2	1	3	6	5	4
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Table 2:

After the operations pivot 3 will its right position . before pivot element 3 all element are smaller than 3 & after pivot element all element are greater than 3

Time Complexity: 1). **Best Case Complexity:** When the partitioning algorithm always chooses the middle element or near the middle element as the pivot, the best case scenario happens. Quicksort's best-case time complexity is $O(n * \log n)$. The following is the best-case recurrence.

$$T(n) = 2T(n/2) + O(n) \quad (1)$$

2). **Average Case Complexity:** This occurs when the array elements are in a disordered sequence that isn't increasing or decreasing properly. Quicksort's average case time complexity is $O(n * \log n)$. The following is the average-case recurrence.

$$O(n * \log n) \quad (2)$$

3). **Worst Case Complexity:** The worst-case situation is when the partitioning algorithm picks the largest or smallest element as the pivot element every time. The worst-case time complexity of quicksort is $O(n^2)$. The following is the worst-case recurrence.

$$T(n) = T(0) + T(n - 1) + O(n) \quad (3)$$