

Data Structure and Algorithms - Quick Sort

Quick sort is a highly efficient sorting algorithm and is based on partitioning of array of data into smaller arrays. A large array is partitioned into two arrays one of which holds values smaller than the specified value, say pivot, based on which the partition is made and another array holds values greater than the pivot value.

Quicksort partitions an array and then calls itself recursively twice to sort the two resulting subarrays. This algorithm is quite efficient for large-sized data sets as its average and worst-case complexity are $O(n \log n)$ and $O(n^2)$, respectively.

Partition in Quick Sort

Following animated representation explains how to find the pivot value in an array.

Unsorted Array



The pivot value divides the list into two parts. And recursively, we find the pivot for each sub-lists until all lists contains only one element.

Quick Sort Pivot Algorithm

Based on our understanding of partitioning in quick sort, we will now try to write an algorithm for it, which is as follows.

- Step 1** - Choose the highest index value has pivot
- Step 2** - Take two variables to point left and right of the list excluding pivot
- Step 3** - left points to the low index
- Step 4** - right points to the high
- Step 5** - while value at left is less than pivot move right
- Step 6** - while value at right is greater than pivot move left
- Step 7** - if both step 5 and step 6 does not match swap left and right
- Step 8** - if $left \geq right$, the point where they met is new pivot

Quick Sort Pivot Pseudocode

The pseudocode for the above algorithm can be derived as –

```
function partitionFunc(left, right, pivot)
    leftPointer = left
    rightPointer = right - 1

    while True do
        while A[++leftPointer] < pivot do
            //do-nothing
        end while

        while rightPointer > 0 && A[--rightPointer] > pivot do
            //do-nothing
        end while

        if leftPointer >= rightPointer
            break
        else
            swap leftPointer, rightPointer
        end if

    end while

    swap leftPointer, right
    return leftPointer

end function
```

Quick Sort Algorithm

Using pivot algorithm recursively, we end up with smaller possible partitions. Each partition is then processed for quick sort. We define recursive algorithm for quicksort as follows –

```
Step 1 - Make the right-most index value pivot
Step 2 - partition the array using pivot value
Step 3 - quicksort left partition recursively
Step 4 - quicksort right partition recursively
```

Quick Sort Pseudocode

To get more into it, let see the pseudocode for quick sort algorithm –

```
procedure quickSort(left, right)

    if right-left <= 0
        return
    else
        pivot = A[right]
        partition = partitionFunc(left, right, pivot)
        quickSort(left,partition-1)
        quickSort(partition+1,right)
    end if

end procedure
```

To know about quick sort implementation in C programming language, please click here .