GeeksforGeeks

A computer science portal for geeks

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When does the worst case of Quicksort occur?

The answer depends on strategy for choosing pivot. In early versions of Quick Sort where leftmost (or rightmost) element is chosen as pivot, the worst occurs in following cases.

1) Array is already sorted in same order.
2) Array is already sorted in reverse order.
3) All elements are same (special case of case 1 and 2)

Since these cases are very common use cases, the problem was easily solved by choosing either a random index for the pivot, choosing the middle index of the partition or (especially for longer partitions) choosing the median of the first, middle and last element of the partition for the pivot. With these modifications, the worst case of Quick sort has less chances to occur, but worst case can still occur if the input array is such that the maximum (or minimum) element is always chosen as pivot.

References:
http://en.wikipedia.org/wiki/Quicksort

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Guest • 10 months ago
For worst case of merge sort, see this : http://stackoverflow.com/a/245...
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Aditya Goel Guest • 3 months ago
check code for converting sorted array to array that will give worst time complexity(max comparisons) i.e. use ouput array generated in the program as input to merge sort program for worst case.

http://ideone.com/oehk4j/
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Arka Prokash Majumadar Guest • 10 months ago

very nice **@Ayush Jain**

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Not jerky Guest • 10 months ago

badhao badhao reputation badhao! :P

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groomnestle • a year ago

The worst case occurs if the chosen pivot happens to be the largest or smallest for each single partition.

So in early implementation which picks first element as pivot worse case would be a sorted array.

In practice this is a very unlikely situation as pivot is chosen randomly or from mid element.

2 • Reply • Share ›

Rajesh • 3 years ago

explain output of merge sort in each pass but it is recursive in nature?

```
/* Paste your code here (You may delete these lines if not writing code) */
```

1 • Reply • Share ›

DS+Algo=Placement Rajesh • 9 months ago

How did u get this code area in comment?

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Himanshu • 4 years ago

Any idea on how the C standard library or C++ standard library prevents these worst case(s) from happening? or, Does the qsort() implementation in C/C++ standard library also suffers from O(n^2) worst case behavior for pathological cases?

• Reply • Share ›

kartik Himanshu • 4 years ago

@Himanshu: I am not sure how standard C++ library prevents worst case from happening. But, I know a way though which we can guarantee that worst case would never occur.

We can find median of array in O(n) time using order statics algorithms. Once we have the median, we can use median as pivot. It will be an ideal pivot dividing the array in two halves. This ways the worst cases never occurs and time complexity remains O(nLogn) for all inputs. Finding median won't increase the time complexity as finding median is O(n) which is same as partition. But, this approach is considered practically slow and not followed.

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neha2210 kartik • 2 years ago

But if median is found in O(n) time, time complexity also depends on the number of times we find the median.
Am I right?

• Reply • Share ›

bharath reddy neha2210 • 2 years ago

But the number of steps is O(logn); so that won't change the time complexity

3 • Reply • Share ›

brahma bharath reddy • a year ago

```
int partition(int a[],int l,int r){
int p=a[r];
int i=l;
for(int j=l;j<=r-1;j++){
if(a[j]<=p){
swap(&a[j],&a[i]);
i++;
}
}
swap(&a[i],&a[r]);
return i;
}
void quick_sort(int a[],int l,int r){
if(l<r){ int="" p="partition(a,l,r);" quick_sort(a,l,p-1);=""
quick_sort(a,p+1,r);="" }="" }="" here="" if="" finding="" the="" pivot=""
takes="" o(n)="" then="" the="" total="" complexity="" becomes=""
o(n^2),="" could="" you="" tell="" me="" how="" it="" is="" taking=""
o(logn)="" steps="" thank="" you..="">
```

• Reply • Share ›

joh • 4 years ago

Could you give an example as why?

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