Royal University of Phnom Penh
Faculty of Engineering

1

Data Structures and Algorithms

Chapter 3
Recursion and Quicksort

DR. SRUN SOVILA

Outline

- Recursion
- Applied Recursion
- Quicksort
- Improving Quicksort

Outline

- Recursion

- Applied Recursion

- Quicksort
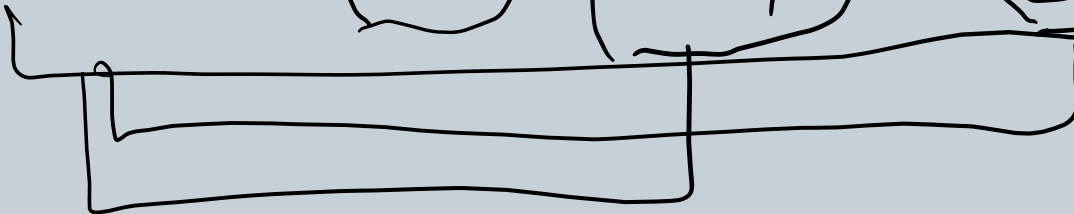
- Improving Quicksort

10   20   30   15   8   (100)

8   (16)   (24)   (28)   (40)   (65)

Problems with Inversely Sorted Data

- If we use quicksort to sort 100 inversely sorted items, the algorithm runs much more slowly
- During partitioning, pivot will be larger then sub-arrays

- Pivot should be larger than half array, and smaller than half array
- Two equal sub-arrays is the optimum situation for the quicksort algorithm
- The worst situation results when a subarray with N elements is divided into one subarray

How to Select Pivot?

- The pivot should be the median of the items being sorted

- The *median* or *middle* item is the data item chosen, it will be divided half smaller and half larger

- Choosing pivot at random is simple but it does NOT always result in a good selection

- The method should be simple but have a good chance of avoiding the largest or smallest value

- Thus, the pivot should be selected by ***Median-of-Three***

Median-of-Three Partitioning

- A compromise solution is to find the median of the *first*, *last*, and *middle* elements of the array, and use this for the pivot

- This is called the *median-of-three*

Median is 44
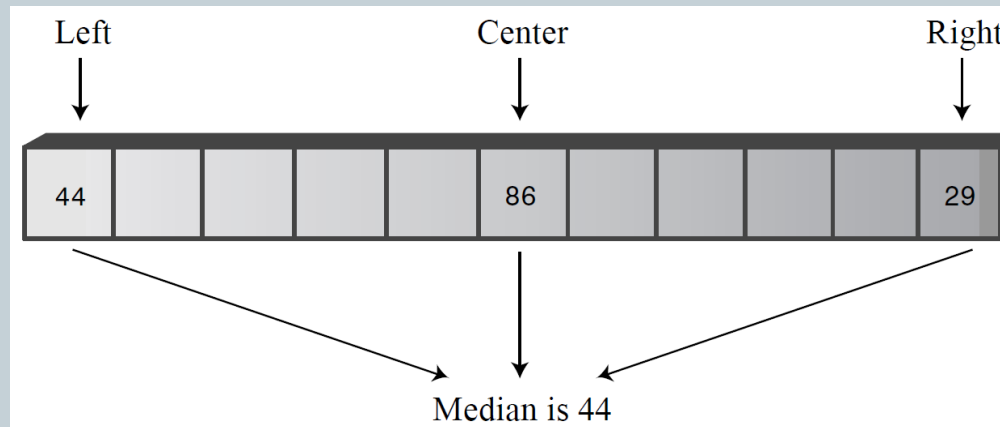
- During finding median, the three element should be sorted (which the smallest is in left, largest is in right, and pivot is in center)


After sorting

Becomes pivot
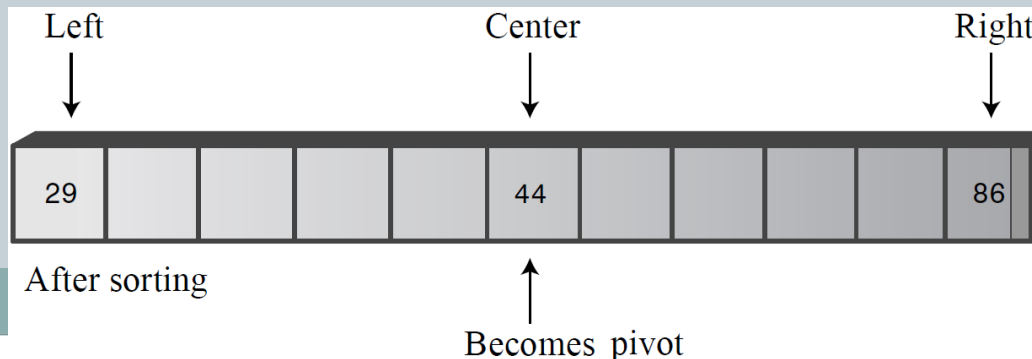
Handling Small Partitions

- If you use the median-of-three partitioning scheme, it will not work for partitions of three or fewer items

- For example, after partitioning we have sub-arrays of 2 and 3 items

- In this case, for the sub-arrays use manual sorting

- Knuth[*] recommends using insertion sort, in case if number item of array is 9

- The Art of Computer Programming by Donald E. Knuth, of Stanford University (Addison Wesley, 1997)
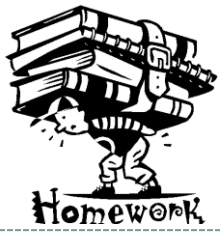
Write a QuickSort program which is:
1. pivot is selected by median-off-three;
2. and using **insertion sort** for sub-arrays, which is number items 2 or 3.

Read book of **Robert Lafore**, page: 205– 279 for next lecture

Late submission: the score will be minus 10% for every hour

End of Chapter 3