Quicksort Using Stack

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Algorithm: QuickSort_Stack(A, N, Lower, Upper)

Here A is the list of items to be sorted and N is the total no. of items in A. Two stacks Lower and Upper are used to hold the position of first item and the position of last item in each sublist respectively.

1. Set Top := 0.
2. If N > 1 then Set Top=Top+1, Lower[Top] := 1 and Upper[Top] := N.
3. Repeat steps until Top ≠ 0
4. Set Beg := Lower[Top], End := Upper[Top] and Top := Top – 1.
5. Call Loc = Pivot(A, Beg, End) // location of partitioning element
6. If Beg < Loc -1 then
   (a) Set Top := Top+1, Lower[Top] := Beg and Upper[Top] := Loc-1
7. If Loc+1 < End then
   (b) Set Top := Top+1, Lower[Top] := Loc+1 and Upper[Top] := End
8. Exit

Algorithm: Pivot(A, Beg, End)

Here A is the list of Items. Beg is the location of the first item and End is the location of the last item in the list.

1. Set Left := Beg, Right := End and Loc := Beg

2. /*….. Scan from Left to Right……*/

(a) Repeat while A[loc] ≤ A[Right] and Loc ≠ Right do Right := Right – 1

(b) If Loc = Right then Return Loc

(c) If A[Loc] > A[Right] then Swap(A[Loc], A[Right]) and Set Loc := Right.

(d) Go to step 3.

3. /*….. Scan from Right to Left……*/

(a) Repeat while A[loc] ≥ A[Left] and Loc ≠ Left do Left := Left + 1

(b) If Loc = Left then Return Loc

(c) If A[Loc] < A[Left] then Swap(A[Loc], A[Left]) and Set Loc := Left.

(d) Go to step 2.

 # Example: A = 44, 33, 11, 55, 77, 90, 40, 60, 99, 22

Solution:

1. Push 1 and 10 onto Lower and Upper respectively. So Lower = 1 and Upper = 10.
2. Pop Lower and Upper, Lower = Ø and Upper = Ø. Call Pivot(A, 1, 10).
3. Scan the list from left to right. Set Loc =1, Left = 1 and Right = 10

   44, 33, 11, 55, 77, 90, 40, 60, 99, 22 [swap 44 and 22]

   Scan from right to left. Set Loc = 10, Left = 1 and Right = 10

   22, 33, 11, 55, 77, 90, 40, 60, 99, 44 [swap 44 and 55]

   Scan from left to right. Set Loc = 4, Left = 4 and Right = 10

   22, 33, 11, 44, 77, 90, 40, 60, 99, 55 [swap 44 and 40]

   Scan from right to left. Set Loc =7, Left = 4 and Right = 7

   22, 33, 11, 40, 77, 90, 44, 60, 99, 55 [swap 44 and 77]

   Scan from left to right. Set Loc = 5, Left = 5 and Right = 7]

   22, 33, 11, 40, 44, **90, 77, 60, 99, 55** [Loc=Right, so stop scanning and Loc = 5]

   Left Sublist Right Sublist

1. Push 1 and 6 onto Lower and 4 and 10 onto Upper respectively.

   So Lower = 1, 6 and Upper = 4, 10.

5. Pop Lower and Upper, Lower = 1 and Upper = 4. Call Pivot(A, 6, 10).

6. Scan the list from left to right. Set Loc = 6, Left = 6 and Right = 10

   22, 33, 11, 40, 44**, 90, 77, 60, 99,** 55 [swap 99 and 55]

   Scan from right to left. Set Loc =10, Left = 6 and Right = 10

   22, 33, 11, 40, 44, **55, 77, 60,** 99**,90** [swap 99 and 90]

   Scan from left to right. Set Loc = 9, Left = 8 and Right = 10

   22, 33, 11, 40, 44, **55, 77, 60,** 90**, 99** [Loc=Right, so stop scanning and Loc = 9]

   Left Sublist

7. Push 6 onto Lower and 8 onto Upper respectively.

   So Lower = 1, 6 and Upper = 4,8.

8. Pop Lower and Upper, Lower = 1 and Upper = 4. Call Pivot(A, 6, 8).

9. Scan the list from left to right. Set Loc = 6, Left = 6 and Right = 8

   22, 33, 11, 40, 44, **55, 77, 60,** 90, 99 [Loc=Right, so stop scanning and Loc = 6]

   Right Sublist

10. Push 7 onto Lower and 8 onto Upper respectively.

    So Lower = 1, 7 and Upper = 4, 8.

11. Pop Lower and Upper, Lower = 1 and Upper = 4. Call Pivot(A, 7, 8)

12. Scan the list from left to right. Set Loc = 7, Left = 7 and Right = 8

    22, 33, 11, 40, 44, 55, **77, 60,** 90, 99 [Swap 77 and 60]

    Scan from right to left. Set Loc = 8, Left = 7 and Right = 8

    22, 33, 11, 40, 44, 55, **60, 77,** 90, 99 [Loc=Left, so stop scanning and Loc = 8]

13. Pop Lower and Upper, Lower = Ø and Upper = Ø. Call Pivot(A, 1, 4).

14. Scan the list from left to right. Set Loc = 1, Left = 1 and Right = 4

22, 33, 11, 40, 44, 55, 60, 77, 90, 99 [Swap 22 and 11]

Scan the list from right to left. Set Loc = 3, Left = 1 and Right = 3

11, 33, 22, 40, 44, 55, 60, 77, 90, 99 [Swap 33 and 22]

Scan the list from left to right. Set Loc = 2, Left = 2 and Right = 3

11, 22, 33, 40, 44, 55, 60, 77, 90, 99 [Loc=Right, so stop scanning and Loc = 2]

Right Sublist

15. Push 3 onto Lower and 4 onto Upper respectively. So Lower = 3 and Upper = 4.

16. Pop Lower and Upper, Lower = Ø and Upper = Ø. Call Pivot(A, 3, 4, Loc).

17. Scan the list from left to right. Set Loc = 2, Left = 2 and Right = 3

11, 22, **33, 40**, 44, 55, 60, 77, 90, 99 [Loc=Right, so stop scanning and Loc = 2]

Sorted List: 11, 22, 33, 40, 44, 55, 60, 77, 90, 99.

END!!!