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In place algorithm java

Inefficience in the easy-to-understand version of Quick Sort Recall: Merge Sort in pseudo code QuickSort(double[] a) { if (a.length ≤ 1) return; // No need to sort Select Pivot; // Usually this is the last elem in[Partition] in 2 halves: left[]: ≤ pivot elements to the right[]: elements > pivot; Sort Left[]; Sort Right[]; Concatenate: left[] pivot right[] } In an easy-to-understand version: we create two new arrays (left[] and right[]) Arrays left[] and right[] contains part of the original array and pass these arrays to another sorting method of merging A more effective way to pass parts of an array There is a better way to pass the anolyting, to sort it: Use the same array It will eliminate copying elements (time saving!!) We specify the range of elements you want to sort by passing the range as variables of the parameters Example: sort(a, z, means: sort ONLY elements between and to (not inclusive): a[from], and[from +1], ... , and[to-1] In place of Quick Sort: The resulting quick sort algorithm will use only one array (input array) It is therefore called: Action in place quick sort algorithm We use the same pseudo code: QuickSort(double[] a) { if (a.length ≤ 1) return; You do not need to sort select pivot; This is usually the last elem in[] Partition a[] in 2 halves: left[]: ≤ pivot elements to the right[]: elements > pivot; Sort Left[]; Sort Right[]; Concatenate: left[] pivot right[] } Jedyna różnica to: Musimy użyć tej samej tablicy w każdej operacji (To, co to znaczy być na miejscu) W Javie: /* ========== a[iRight-1] ==========int iLeft, int iRight) { if (iRight - iLeft ≤ 1) { // Pusta tablica lub tablica 1 elementu nie wymaga sortowania ! return; } k = partycja(a, iLeft, iRight); // Zwraca poz. z pivit po partycjonowaniu QuickSort(a, iLeft, k); // Sortuj lewą połowę tablicy podzielonej QucikSort(a, k+1, iRight); // Sortowanie prawej połowy tablicy podzielonej na partycje // Krok catenate nie jest konieczny !!! // Nie ma potrzeby łączenia 2 posortowanych tablic // ponieważ sortowanie miało miejsce wewnątrz tablicy wejściowej !!! } Note: The effect of the call partition (a, iLeft, iRight) is the following call partition call (a, iLeft, iRight) will partition items: a[iLeft] a[iLeft+1] ..... a[iRight-1] by selecting pivot = a[iRight-1], and split elements into 2 halves: Left half contains only values that are ≤ rotation element Right half contains only values that are > rotation element Example 1: partition connection effect() Example 2: partition() can use part of partition() array must use the same array (i.e. input array a[]) This is called partition algorithm in place We will discuss we will discuss partition algorithm later (This is the most complex part in place of the quick sort algorithm) More details about what the partition() method does can be found here: click here first I will show you how the algorithm works before discussing the in-place partitioning algorithm Activity in place quick sort algorithm I will now illustrate how the quick sort algorithm site works using the example.... How the quick sort algorithm works in place: Input array: To sort an array, we call: QuickSort(a, 0, 8) (note that iRight = 8) QuickSort (a, 0, 8) first partitions the array: Note that: the method call partition (a, 0, 8) will change the input array !!! When the partition(s, 0, 8) is executed, it returns index 3 (that is, the rotation position): (Note that the input array will be changed in place) QuickSort(a, 0, 8) will then call QuickSort (a, 0, 3) to sort the left array: QuickSort (a, 0, 3) first partition of the array: partition (a, 0, 3) will return index 1 (this pivot position) QuickSort (a , 0, 3) will then call QuickSort (a , 0, 1) to sort the left array: Because the array has one element, QuickSort (a, 0, 1) immediately returns QuickSort (a, 0, 3) will next call QuickSort (a, 2(= k +1), 3) to sort the right array: Since the array has one element, QuickSort (a, 2, 3) returns immediately back to QuickSort (a, 0, 3) and this method is now finally complete and back : We return to QuickSort (a, 0, 8), the input board will look like this: I QuickSort (a, 0, 8) will call QuickSort (a, 4 (= k + 1), 8) to sort the corresponding array: It will repeat and sort the correct array (will not picture.... too much to draw) Here is a printout of the actual execution in place of the quick sort algorithm using the input above: Before sorting: [6.4, 2.5, 9.2, 3.5, 8.9, 1.1, 7.5, 4.2] **QuickSort(a, 0, 8)** Input: [6.4, 2.5, 9.2, 3.5, 8.9, 1.1, 7.5, 4.2] a[] = [6.4, 2.5, 9.2, 3.5, 8.9, 1.1, 7.5, 4.2] Pivot = 4.2 After partition: [1.1 , 3.5, 2.5, 4.2, 9.2, 8.9, 6.4 , 7.5] **QuickSort(a, 0, 3)** Input: [1.1, 3.5, 2.5] a[] = [1.1, 3.5, 2.5, 4.2, 9.2, 8.9, 6.4, 7.5] Pivot = 2.5 After partition: [1.1, 2.5, 3.5, 4.2, 9.2, 8.9, 6.4, 7.5] **QuickSort(a, 0, 1)** Input: [1 1.1] a[] = [1.1, 2.5, 3.5, 4.2, 9.2, 8.9, 6.4, 7.5] Done. (**QuickSort(a, 0, 1)**) **QuickSort(a, 2, 3)** Input: [3.5] a[] = [1.1, 2.5, 3.5, 4.2, 9.2, 8.9, 6.4, 7.5] Done. (**QuickSort,2, 3)**) [1.1] [3.5] Combined cuts = [1.1, 2.5, 3.5] a[] = [1.1, 2.5, 3.5, 4.2, 9.2, 8.9, 6.4, 7.5] Done. (**QuickSort, 0, 3)**) **QuickSort(a, 4, 8)** Input: [9.2, 8.9, 6.4, 7.5] a[] = [1.1, 2.5, 3.5, 4.2, 9.2, 8.9, 6.4, 7.5] Pivot = 7.5 After partition: [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] Input: [6.4] a[] = [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] Done. Input: [8.9, 9.2] a[] = [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, Rotation = 9.2 After partition: [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 8.9, Input: [8.9] a[] = [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] Done. Input: [] a[] = [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] Done. [8.9] [] Concatented pieces = [8.9, 9.2] a[] = [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] [6.4] [8.9, 9.2] Concatented pieces = [6.4, 7.5, 8.9, 9.2] a[] = [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] [1.1, 2.5, 3.5] [6.4, 7.5, 8.9, 9.2] Concatented pieces = [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] a[] = [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] After sort: [1.1, 2.5, 3.5, 4.2, 6.4, 7.5, 8.9, 9.2] The in-place partition algorithm Recall that the in-place Quick Sort algorithm: /* ========== Sort: a[iLeft] a[iLeft+1] .... a[iRight-1] ========== */ void QuickSort(double[] a, int iLeft, int iRight) { if (iRight - iLeft ≤ 1) { // An empty array or an array of 1 element don't need sorting ! return; } k = partition(a, iLeft, iRight); // Returns the pos. of pivit after partitioning QuickSort(a, iLeft, k); // Sort left half of partitioned array QucikSort(a, k+1, iRight); // Sort right half of partitioned array } must partition the array a[] in-place Examples: Example 1: Explanation: partition(a, 0, 8) will partition the array elements: a[0] a[1] a[2] a[3] a[4] a[5] a[6] a[7] First, we select the pivot = a[4] 7] (= 4.2) Then the rest of the array elements are partitioned in 2 halves: left half with values ≤ 4.2 ===> 2.5 3.5 1.1 right half with values > 4.2 ===> 6.4 9.2 8.9 7.5 Example 2 : Explanation: Partition (a, 0, 4) will divide the array elements: a[0] a[1] a[2] a[3] (3 = 4-1) First select pivot = a[3] (= 3.5) Then the remaining elements of the array are divided into 2 halves: left half with values ≤ 3.5 ===> 2.5 right half with values > 3.5 ===> 9.2 6.4 Dicdactical note: I will illustrate the algorithm steps in place with the following input: inside the algorithm description ! The main idea of the partition algorithm in place: Support for 3 segments in an array: Segment 1 contains values that are ≤ PivotTable Segment 2 contains values that are > PivotChart 3 contains values that have not been processed There is an empty slot in the array between segment 2 and segment 3. The algorithm works as follows: If[larger_I - 1] > pivot then: add[larger_I - 1] to segment 2: If[larger_I - 1] ≤ pivot then: add[larger_I - 1] to segment 1: Algorithm to execute partitions in place: int partition(double[] a, int iLeft, int iRight) { 1. Save pivot in help variable: pivot = a[iRight-1]; (Result: we also make a hole in the board!) 2. Set 2 indexes to plot segments: smaller_I = iLeft; larger_I = iRight-1; (Result: we also make a hole in the board!) 3. during (larger_I > smaller_I) { (At the moment we have this situation:) if (a[larger_I - 1] > pivot Place a[larger_I -1] in segment 2 and move larger_I down ==========larger_I larger_I========== (Result:) } else { /* ==========larger_I========== a[smaller_I] = pomoc; smaller_I++; (Result:) } } 4. Place the pivot in its place[larger_I] = pivot; 5. Return of rotation position: return (larger_I); } partition() method in Java: public static partition int(double[] a, int iLeft, int iRight) { double pivot; double help; int smaller_I, larger_I; smaller_I = iLeft; larger_I = iRight-1; pivot = a[iRight-1]; Otwór jest początkowo w[iRight-1] podczas (larger_I > smaller_I) { jeśli (a[larger_I -1] > pivot) { /* ==========larger_I========== = a[larger_I -1]; larger_I--; } inne { /* ==larger_I========== -1] help = a[larger_I -1]; a[larger_I -1] = a[smaller_I]; a[smaller_I] = help; smaller_I++; } } a[larger_I] = pivot; Place the rotation in the larger_I; } Recall the quick sort algorithm on the spot, which uses a partitioning algorithm in place: in place of the split algorithm): /* ========== and[iRight-1] iRight) { if (iRight - iLeft ≤ 1) { // Empty array or array 1 element does not require sorting ! return; } k = partition(a, iLeft, iRight); // Returns the pivit item after partitioning QuickSort(a, iLeft, k); // Sort the left half of the divided array QucikSort(a, k+1, iRight); // Sort the right half of the partitioned array } (This is the same method above, I just repeated it for context) How to use QuickSort: (demo program) public static void main(String[] args) { double[] x = {6.4, 2.5, 9.2, 3.5, 8.9, 1.1, 7.5, 4.2} ; System.out.println(Before sorting: + Arrays.toString(x) +); QuickSort.sort(x, 0, x.length); Quick sort System.out.println(After sorting: + Arrays.toString(x)); } Sample program: (Demo code above) How to run the program: Right-click on the link and save in the scratch directory Compile: javac testProg.java To run: java testProgx testProgx testProgx testProgx

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