Code : 1  
package Topic\_12\_TimeAndSpaceComplexity;

import java.util.Scanner;

public class A\_BubbleSort {

public static void bubbleSort(int[] arr) {

int n = arr.length;

for (int itr = 1; itr < n; itr++) {

for (int j = 0; j < n - itr; j++) {

if (isSmaller(arr, j + 1, j) == true) {

swap(arr, j + 1, j);

}

}

}

}

// used for swapping ith and jth elements of array

public static void swap(int[] arr, int i, int j) {

System.out.println("Swapping " + arr[i] + " and " + arr[j]);

int temp = arr[i];

arr[i] = arr[j];

arr[j] = temp;

}

// return true if ith element is smaller than jth element

public static boolean isSmaller(int[] arr, int i, int j) {

System.out.println("Comparing " + arr[i] + " and " + arr[j]);

if (arr[i] < arr[j]) {

return true;

} else {

return false;

}

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.println(arr[i]);

}

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

bubbleSort(arr);

print(arr);

}

}

Code : 2  
package Topic\_12\_TimeAndSpaceComplexity;

import java.util.Scanner;

public class B\_SelectionSort {

public static void selectionSort(int[] arr) {

int n = arr.length;

for (int i = 0; i < n - 1; i++) {

int minidx = i;

for (int j = i + 1; j < n; j++) {

if (isSmaller(arr, j, minidx)) {

minidx = j;

}

}

swap(arr, i, minidx);

}

}

// used for swapping ith and jth elements of array

public static void swap(int[] arr, int i, int j) {

System.out.println("Swapping " + arr[i] + " and " + arr[j]);

int temp = arr[i];

arr[i] = arr[j];

arr[j] = temp;

}

// return true if ith element is smaller than jth element

public static boolean isSmaller(int[] arr, int i, int j) {

System.out.println("Comparing " + arr[i] + " and " + arr[j]);

if (arr[i] < arr[j]) {

return true;

} else {

return false;

}

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.println(arr[i]);

}

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

selectionSort(arr);

print(arr);

}

}

Code : 3  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class C\_InsertionSort {

public static void insertionSort(int[] arr) {

for (int i = 1; i < arr.length; i++) {

for (int j = i - 1; j >= 0; j--) {

if (isGreater(arr, j, j + 1)) {

swap(arr, j, j + 1);

} else {

break;

}

}

}

}

// used for swapping ith and jth elements of array

public static void swap(int[] arr, int i, int j) {

System.out.println("Swapping " + arr[i] + " and " + arr[j]);

int temp = arr[i];

arr[i] = arr[j];

arr[j] = temp;

}

// return true if jth element is greater than ith element

public static boolean isGreater(int[] arr, int j, int i) {

System.out.println("Comparing " + arr[i] + " and " + arr[j]);

if (arr[i] < arr[j]) {

return true;

} else {

return false;

}

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.println(arr[i]);

}

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

insertionSort(arr);

print(arr);

}

}

Code : 4  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class D\_MergeTwoSortedArray {

public static int[] mergeTwoSortedArrays(int[] a, int[] b) {

// write your code here

int alen = a.length;

int blen = b.length;

int[] res = new int[alen + blen];

int i = 0;

int j = 0;

int k = 0;

// when there are elements in both the array

while (i < alen && j < blen) {

if (a[i] < b[j]) {

res[k] = a[i];

i++;

} else {

res[k] = b[j];

j++;

}

k++;

}

while (i < alen) {

res[k] = a[i];

i++;

k++;

}

while (j < blen) {

res[k] = b[j];

j++;

k++;

}

return res;

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.println(arr[i]);

}

}

public static void main(String[] args) {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] a = new int[n];

for (int i = 0; i < n; i++) {

a[i] = scn.nextInt();

}

int m = scn.nextInt();

int[] b = new int[m];

for (int i = 0; i < m; i++) {

b[i] = scn.nextInt();

}

int[] mergedArray = mergeTwoSortedArrays(a, b);

print(mergedArray);

}

}

Code : 5  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class E\_MergeSort {

public static int[] mergeSort(int[] arr, int lo, int hi) { //1

if (lo == hi) { //2

int[] ba = new int[1];

ba[0] = arr[lo];

return ba;

}

int mid = (lo + hi) / 2; //3

int[] f = mergeSort(arr, lo, mid); //4

int[] s = mergeSort(arr, mid + 1, hi); //5

int[] fin = mergeTwoSortedArrays(f, s); //6

return fin; //7

}

//used for merging two sorted arrays

public static int[] mergeTwoSortedArrays(int[] a, int[] b) {

System.out.println("Merging these two arrays ");

System.out.print("left array -> ");

print(a);

System.out.print("right array -> ");

print(b);

int i = 0, j = 0, k = 0;

int[] ans = new int[a.length + b.length];

while (i < a.length && j < b.length) {

if (a[i] <= b[j]) {

ans[k] = a[i];

i++;

k++;

} else {

ans[k] = b[j];

j++;

k++;

}

}

while (i < a.length) {

ans[k] = a[i];

k++;

i++;

}

while (j < b.length) {

ans[k] = b[j];

k++;

j++;

}

return ans;

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.print(arr[i] + " ");

}

System.out.println();

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

int[] sa = mergeSort(arr, 0, arr.length - 1);

System.out.print("Sorted Array -> ");

print(sa);

}

}

Code : 6  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class F\_PartitionAnArray {

public static void partition(int[] arr, int pivot) {

int i = 0;

int j = 0;

while (i < arr.length) {

if (arr[i] > pivot) {

i++;

} else if (arr[i] <= pivot) {

swap(arr, i, j);

i++;

j++;

}

}

}

// used for swapping ith and jth elements of array

public static void swap(int[] arr, int i, int j) {

System.out.println("Swapping " + arr[i] + " and " + arr[j]);

int temp = arr[i];

arr[i] = arr[j];

arr[j] = temp;

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.print(arr[i] + " ");

}

System.out.println();

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

int pivot = scn.nextInt();

partition(arr, pivot);

print(arr);

}

}

Code : 7  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class G\_QuickSort {

public static void quickSort(int[] arr, int lo, int hi) {

if (lo > hi) { // lo>=hi will work same

return;

}

int pivot = arr[hi];

int pi = partition(arr, pivot, lo, hi);

quickSort(arr, lo, pi - 1);

quickSort(arr, pi + 1, hi);

}

public static int partition(int[] arr, int pivot, int lo, int hi) {

System.out.println("pivot -> " + pivot);

int i = lo, j = lo;

while (i <= hi) {

if (arr[i] <= pivot) {

swap(arr, i, j);

i++;

j++;

} else {

i++;

}

}

System.out.println("pivot index -> " + (j - 1));

return (j - 1);

}

// used for swapping ith and jth elements of array

public static void swap(int[] arr, int i, int j) {

System.out.println("Swapping " + arr[i] + " and " + arr[j]);

int temp = arr[i];

arr[i] = arr[j];

arr[j] = temp;

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.print(arr[i] + " ");

}

System.out.println();

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

quickSort(arr, 0, arr.length - 1);

print(arr);

}

}

Code : 8  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class H\_QuickSelect {

public static int quickSelect(int[] arr, int lo, int hi, int k) {

int pivot = arr[hi];

int pidx = partition(arr, pivot, lo, hi);

if (k == pidx) {

return pivot;

} else if (k > pidx) {

return quickSelect(arr, pidx + 1, hi, k);

} else {

return quickSelect(arr, lo, pidx - 1, k);

}

}

public static int partition(int[] arr, int pivot, int lo, int hi) {

System.out.println("pivot -> " + pivot);

int i = lo, j = lo;

while (i <= hi) {

if (arr[i] <= pivot) {

swap(arr, i, j);

i++;

j++;

} else {

i++;

}

}

System.out.println("pivot index -> " + (j - 1));

return (j - 1);

// j is first among (larger than pivot) numbers

// pivot lives at j - 1, and it is at it's correct sorted postion

}

// used for swapping ith and jth elements of array

public static void swap(int[] arr, int i, int j) {

System.out.println("Swapping " + arr[i] + " and " + arr[j]);

int temp = arr[i];

arr[i] = arr[j];

arr[j] = temp;

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.print(arr[i] + " ");

}

System.out.println();

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

int k = scn.nextInt();

System.out.println(quickSelect(arr, 0, arr.length - 1, k - 1));

}

}

Code : 9  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class I\_CountSort {

public static void countSort(int[] arr, int min, int max) {

int range = max - min + 1;

int[] ans = new int[arr.length];

//make frequency arr

int[] farr = new int[range];

for (int i = 0; i < arr.length; i++) {

farr[arr[i] - min]++;

}

//convert it into prefix sum array

for (int i = 1; i < farr.length; i++) {

farr[i] += farr[i - 1];

}

//stable sorting(filling ans array)

for (int i = arr.length - 1; i >= 0; i--) {

int pos = farr[arr[i] - min] - 1;

ans[pos] = arr[i];

farr[arr[i] - min]--;

}

//filling original array with the help of ans array

for (int i = 0; i < arr.length; i++) {

arr[i] = ans[i];

}

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.println(arr[i]);

}

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

int max = Integer.MIN\_VALUE;

int min = Integer.MAX\_VALUE;

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

max = Math.max(max, arr[i]);

min = Math.min(min, arr[i]);

}

countSort(arr, min, max);

print(arr);

}

}

Code : 10  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class J\_RadixSort {

public static void radixSort(int[] arr) {

int max = Integer.MIN\_VALUE;

for (int i = 0; i < arr.length; i++) {

max = Math.max(max, arr[i]);

}

//call countSort for every digit from right to left

for (int exp = 1; max / exp >= 1; exp \*= 10)

countSort(arr, exp);

}

public static void countSort(int[] arr, int exp) {

int[] ans = new int[arr.length];

// make frequency arr

int[] farr = new int[10];

for (int i = 0; i < arr.length; i++) {

farr[(arr[i] / exp) % 10]++;

}

// convert it into prefix sum array

for (int i = 1; i < farr.length; i++) {

farr[i] += farr[i - 1];

}

// stable sorting(filling ans array)

for (int i = arr.length - 1; i >= 0; i--) {

int pos = farr[(arr[i] / exp) % 10] - 1;

ans[pos] = arr[i];

farr[(arr[i] / exp) % 10]--;

}

// filling original array with the help of ans array

for (int i = 0; i < arr.length; i++) {

arr[i] = ans[i];

}

System.out.print("After sorting on " + exp + " place -> ");

print(arr);

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.print(arr[i] + " ");

}

System.out.println();

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

radixSort(arr);

print(arr);

}

}

Code : 11  
package Topic\_12\_TimeAndSpaceComplexity;

import java.util.\*;

public class K\_SortDates {

public static void sortDates(String[] arr) {

countSort(arr, 1000000, 100, 32);

countSort(arr, 10000, 100, 13);

countSort(arr, 1, 10000, 2501);

}

public static void countSort(String[] arr, int div, int mod, int range) {

String[] ans = new String[arr.length];

// make frequency arr

int[] farr = new int[range];

for (int i = 0; i < arr.length; i++) {

farr[Integer.parseInt(arr[i], 10) / div % mod]++;

}

// convert it into prefix sum array

for (int i = 1; i < farr.length; i++) {

farr[i] += farr[i - 1];

}

// stable sorting(filling ans array)

for (int i = arr.length - 1; i >= 0; i--) {

int pos = farr[Integer.parseInt(arr[i], 10) / div % mod] - 1;

ans[pos] = arr[i];

farr[Integer.parseInt(arr[i], 10) / div % mod]--;

}

// filling original array with the help of ans array

for (int i = 0; i < arr.length; i++) {

arr[i] = ans[i];

}

}

public static void print(String[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.println(arr[i]);

}

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

String[] arr = new String[n];

for (int i = 0; i < n; i++) {

String str = scn.next();

arr[i] = str;

}

sortDates(arr);

print(arr);

}

}

Code : 12  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class L\_Sort01 {

public static void sort01(int[] arr) {

// 0 to j-1 -> All Zeroes //

// j to i-1 -> All One's //

/\* i to arr.length-1 -> All unknowns \*/

int i = 0, j = 0;

while (i < arr.length) {

if (arr[i] == 0) {

swap(arr, i, j);

i++;

j++;

} else {

i++;

}

}

}

// used for swapping ith and jth elements of array

public static void swap(int[] arr, int i, int j) {

System.out.println("Swapping index " + i + " and index " + j);

int temp = arr[i];

arr[i] = arr[j];

arr[j] = temp;

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.println(arr[i]);

}

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

sort01(arr);

print(arr);

}

}

Code : 13  
package Topic\_12\_TimeAndSpaceComplexity;

import java.util.\*;

public class M\_Sort012 {

public static void sort012(int[] arr) {

// 0 to j-1 -> All Zeroes

// j to i-1 -> All One's

// i to k - 1 -> All unknowns

// k to last -> All Two's

int i = 0, j = 0, k = arr.length - 1;

while (i <= k) {

if (arr[i] == 0) {

swap(arr, i, j);

i++;

j++;

} else if (arr[i] == 1) {

i++;

} else {

swap(arr, i, k);

k--;

}

}

}

// used for swapping ith and jth elements of array

public static void swap(int[] arr, int i, int j) {

System.out.println("Swapping index " + i + " and index " + j);

int temp = arr[i];

arr[i] = arr[j];

arr[j] = temp;

}

public static void print(int[] arr) {

for (int i = 0; i < arr.length; i++) {

System.out.println(arr[i]);

}

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

sort012(arr);

print(arr);

}

}

Code : 14  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class N\_TargetSumPair1 {

public static void targetSumPair(int[] arr, int target) {

Arrays.sort(arr);

int left = 0, right = arr.length - 1;

while (left < right) {

if (arr[left] + arr[right] == target) {

System.out.println(arr[left] + ", " + arr[right]);

left++;

right--;

} else if (arr[left] + arr[right] > target) {

right--;

} else {

left++;

}

}

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

int target = scn.nextInt();

targetSumPair(arr, target);

}

}

Code : 15  
package Topic\_12\_TimeAndSpaceComplexity;

import java.io.\*;

import java.util.\*;

public class O\_PivotOfSortedRotatedArray {

public static int findPivot(int[] arr) {

int lo = 0, hi = arr.length - 1;

while (lo < hi) {

int mid = (lo + hi) / 2;

if (arr[mid] > arr[hi]) {

lo = mid + 1;

} else {

hi = mid;

}

}

return arr[lo];

}

public static void main(String[] args) throws Exception {

Scanner scn = new Scanner(System.in);

int n = scn.nextInt();

int[] arr = new int[n];

for (int i = 0; i < n; i++) {

arr[i] = scn.nextInt();

}

int pivot = findPivot(arr);

System.out.println(pivot);

}

}