import java.util.Random;

import java.util.Scanner;

public class QuickSort {

public static void deterministicQuickSort(int[] arr, int low, int high) {

if (low < high) {

int pivotIndex = deterministicPartition(arr, low, high);

deterministicQuickSort(arr, low, pivotIndex - 1);

deterministicQuickSort(arr, pivotIndex + 1, high);

}

}

public static int deterministicPartition(int[] arr, int low, int high) {

int pivot = arr[low];

int left = low + 1;

int right = high;

while (true) {

while (left <= right && arr[left] <= pivot) {

left++;

}

while (arr[right] >= pivot && right >= left) {

right--;

}

if (right < left) {

break;

} else {

int temp = arr[left];

arr[left] = arr[right];

arr[right] = temp;

}

}

int temp = arr[low];

arr[low] = arr[right];

arr[right] = temp;

return right;

}

public static void randomizedQuickSort(int[] arr, int low, int high) {

if (low < high) {

int pivotIndex = randomizedPartition(arr, low, high);

randomizedQuickSort(arr, low, pivotIndex - 1);

randomizedQuickSort(arr, pivotIndex + 1, high);

}

}

public static int randomizedPartition(int[] arr, int low, int high) {

int pivotIndex = new Random().nextInt(high - low + 1) + low;

int temp = arr[pivotIndex];

arr[pivotIndex] = arr[high];

arr[high] = temp;

return deterministicPartition(arr, low, high);

}

public static void main(String[] args) {

Scanner scanner = new Scanner(System.in);

System.out.print("Enter the number of elements: ");

int n = scanner.nextInt();

int[] arr = new int[n];

System.out.println("Enter the elements:");

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

arr[i] = scanner.nextInt();

}

System.out.println("Choose the sorting variant:");

System.out.println("1. Deterministic Quick Sort");

System.out.println("2. Randomized Quick Sort");

int choice = scanner.nextInt();

if (choice == 1) {

deterministicQuickSort(arr, 0, n - 1);

} else if (choice == 2) {

randomizedQuickSort(arr, 0, n - 1);

} else {

System.out.println("Invalid choice");

return;

}

System.out.println("Sorted array:");

for (int num : arr) {

System.out.print(num + " ");

}

scanner.close();

}

}