**Algorithm: Lab5 (By Sujiv Shrestha ID:610145)**

**Problem 1.**

1. Show all steps of QuickSort in sorting the array [1, 6, 2, 4, 3, 5]. Use leftmost values as pivots at each step.

**Problem2**

2. Show all steps of In-Place QuickSort in sorting the array [1, 6, 2, 4, 3, 5] when doing first partition. Use leftmost values as pivots.

Step 1: k=0

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | 6 | 2 | 4 | 3 | 5 |
| 0 | 1 | 2 | 3 | 4 | 5 |

↑ **Pivot**

Step 2: Swap kth element with rightmost element (rth)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 5 | 6 | 2 | 4 | 3 | 1 |
| 0 | 1 | 2 | 3 | 4 | 5 |

↑ **Pivot**

Step 3: x = 1 (pivot element)

Step 4: in-place partition and get position of pivot point i = 0

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | 5 | 6 | 2 | 4 | 3 |
| 0 | 1 | 2 | 3 | 4 | 5 |

↑ **Pivot**

**Problem3**

3. In our average case analysis of QuickSort, we defined a *good self-call* to be one in which the pivot *x* is chosen so that number of elements < x is less than 3n/4, and also the number of elements > x is less than 3n/4. We call an x with these properties a *good pivot.* When n is a power of 2, it is not hard to see that at least half of the elements in an n-element array could be used as a good pivot (exactly half if there are no duplicates). For this exercise, you will verify this property for the array A = [5, 1, 4, 3, 6, 2, 7, 1, 3] (here, n = 9). Note: For this analysis, use the version of QuickSort in which partitioning produces 3 subsequences *L, E, R* of the input sequence *S.*

a. Which x in A are good pivots? In other words, which values x in A satisfy:

i. the number of elements < x is less than 3n/4, and also

ii. the number of elements > x is less than 3n/4

Answer:

Input Array:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 5 | 1 | 4 | 3 | 6 | 2 | 7 | 1 | 3 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Input Array in sorted order:

s

Good pivot points

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

b. Is it true that at least half the elements of A are good pivots?

4.

**Problem4**

**Problem5**

**private** **static** **int**[] combine(**int**[] x, **int**[] y) {

**int**[] z = **new** **int**[x.length+y.length];

**int** c = 0;

**for**(**int** i:x) {

z[c++] = i;

}

**for**(**int** j:y) {

z[c++]=j;

}

**return** z;

}