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**1.**

{10, 99, 23, 12, 0, 5, 9, 8}

{10,99,23,12} {0,5,9,8}

{10,99} {23,12} {0,5} {9,8}

{10} {99} {23} {12} {0} {5} {9} {8}

{10,99} {12,23} {0,5} {8,9}

{10,12,23,99} {0,5,8,9}

{0,5, 8, 9,10,12,23,99}

**2.** The running time is O(N). Because if we have a loop to insert same elements, the loop will terminates right at first try . So the running time should be O(N) which depends on how many elements are there to sort.

**3. 1)**

F(n)=2F(n/2)+n

F(n)=2(2F(n/4) + n/2)) + n = 4F(n/4)+2n

F(n)=2kF(n/2k)+kn

when n/2k = 1 k=log2n

so F(n)=2log2n F(n/2log2n)+ nlog2n

= nF(1)+nlog2n

=n+nlog2n

**2)**

T(n)=nlog2n+2n-1 F(n)= n+nlog2n

proof: need to show: n+nlog2n=O(nlog2n+2n-1)

n+nlog2n=Ω(nlog2n+2n-1)

Let C1 = 2 when n ≥ 1 C1(nlog2n+2n-1) =nlog2n+ nlog2n+4n-2 > nlog2n+n

Thus, choose n0=1 we have nlog2n+2n-1 ≥ n+nlog2n when n0 ≥ n

Let C1 = 0.5 when n ≥ 1 C1(nlog2n+2n-1) =0.5nlog2n +4n-2 < nlog2n+n

Thus, choose n0=1 we have nlog2n+2n-1 ≤ n+nlog2n when n0 ≤ n

Therefore F(n) =θ(T(n))

**4. Report**

InsertionSort QuickSort

10 9.53674e-07 9.53674e-07

20 2.86102e-06 5.00679e-06

100 1.88351e-05 1.19209e-05

200 5.19753e-05 1.78814e-05

400 2.44856e-04 4.57764e-05

800 2.29692e-03 1.60933e-04

1600 3.26395e-03 1.78099e-04

3200 0.0304101 0.000496864

6400 0.0869331 0.00106311