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Programming Assignment#1  
CSCI 323  
Due Date: 11/06/17  
Submitted date: 11/06/17

Source Codes:

```
import java.io.File;
import java.io.FileNotFoundException;
import java.util.Scanner;

//implementation to sort array by using the insertion sort
public class InsertionSort {
    static int insertCount=0;

    // function to sort array using insertion sort
    public static void Insertionsort(int A[])
    {
        int n = A.length;
        for (int j = 1; j < n; j++)
        {
            int key = A[j];
            int i = j-1;
            while ( ( i >= 0 ) && ( A [i] > key ) )
            {
                insertCount=insertCount+1;//incrementing the global count for quick sort
                A[i+1] = A [i];
                i--;
            }
            A[i+1] = key;
        }
    }
}
```

---

```
public class MergeSort {
    static int MergeCount=0;

    public class MergeSort8 {
        static int MergeCount=0;

        public static void Merge_Sort(int[] A,int p,int r)
        {
            if(p<r)
            {
                int q=(p+r)/2;
                Merge_Sort(A, p, q);
                Merge_Sort(A, q+1, r);
                Merge(A,p,q,r);
            }
        }
    }
}
```

```

    }
}

public static void Merge(int[] A,int p,int q,int r)
{
    int n1=q-p+1;
    int n2=r-q;
    int[] L=new int[n1+2];
    int[] R=new int[n2+2];
    int i,j;
    for(i=1;i<=n1;i++)
        L[i]=A[p+i-1];
    for(j=1;j<=n2;j++)
        R[j]=A[q+j];
    L[n1+1]=Integer.MAX_VALUE;
    R[n2+1]=Integer.MAX_VALUE;
    i=1;
    j=1;
    for(int k=p;k<=r;k++)
    {
        MergeCount++;
        if(L[i]<=R[j])
        {
            A[k]=L[i];
            i++;
        }
        else
        {
            A[k]=R[j];
            j++;
        }
    }
}

// function to sort array using merge()
static void Mergesort(int A[], int p, int r)

```

```

{
    if (p < r)
    {
        int q = (p+r)/2;

        // Sorts the first and second halves part
        Mergesort(A, p, q);
        Mergesort(A, q+1, r);

        // Merges the sorted halves
        merge(A, p, q, r);
    }
}

```

---

```

public class HeapSort {
    public static int heapCount=0;
    public static int N;
    public static void Heapsort(int A[])

    {

        Build_Max_Heap(A);

        for (int i = N; i > 0; i--)
        {

            int temp = A[0];
            A[0] = A[i];
            A[i] = temp;

            N = N-1;

            Max_Heapify(A, 0);

        }

    }

    public static void Max_Heapify(int[] A, int i) {
        int l = 2*i;
        int r = 2*i + 1;
        int max;

        if (l <= N && A[l] > A[i]) {
            max = l;
        }
        else {
            max = i;
        }
        if (r <= N && A[r] > A[max]) {
            max = r;
        }
        if (max != i) {
            int temp = A[i];
            A[i] = A[max];
            A[max] = temp;
            heapCount += 1;
            Max_Heapify(A, max);
        }
    }
}

```

```

    public static void Build_Max_Heap(int[] A) {
        N = A.length - 1;
        for (int i = N/2; i >= 0; i--) {
            Max_Heapify(A, i);
        }
    }

```

---

```

public class QuickSort16384 {
    static int quickCount=0;

    static int partition(int A[], int p, int r)
    {
        int x = A[r];
        int i = p-1; // index of smaller element
        for (int j=p; j<=r-1; j++)
        {
            // If current element is smaller than or
            // equal to x
            quickCount=quickCount+1; //incrementing global variable for quick sort
            if (A[j] <= x)
            {
                i++;

                // swap A[i] and A[j]
                int temp = A[i];
                A[i] = A[j];
                A[j] = temp;
            }
        }

        // swap A[i+1] and A[r] (or x)
        int temp = A[i+1];
        A[i+1] = A[r];
        A[r] = temp;

        return i+1;
    }

    static void Quicksort(int A[], int p, int r)
    {
        if (p < r)
        {
            int q = partition(A, p, r);

            // Recursively sort elements before
            // partition and after partition
            Quicksort(A, p, q-1);
            Quicksort(A, q+1, r);
        }
    }
}

```

---

Test Case Summary:

	<i>Insertion sort</i>	<i>Merge Sort</i>	<i>Heapsort</i>	<i>Quicksort</i>
<i>Num8.txt</i>	14	24	17	16
<i>Num16.txt</i>	84	64	49	55
<i>Num32.txt</i>	249	160	140	123
<i>Num64.txt</i>	966	384	331	394
<i>Num128.txt</i>	4195	896	794	901
<i>Num256.txt</i>	15372	2048	1845	2123
<i>Num512.txt</i>	67408	4608	4133	4873
<i>Num1024.txt</i>	248966	10240	9422	11049
<i>Num2048.txt</i>	1009704	22528	20805	24573
<i>Num4096.txt</i>	4024739	49152	45677	54225
<i>Num8192.txt</i>	16014588	106496	99548	128095
<i>Num16384.txt</i>	64403841	229376	215391	285822

<terminated> InsertionSort8 [Java Applicati

...Insertion sort...

count 14

1  
2  
3  
4  
5  
6  
7  
8|

...Insertion sort...

count 84

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16

...Insertion sort...

count 966

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
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49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64

...Insertion sort...

count 4195

Sorted [50] = 51  
Sorted [51] = 51  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101

```
...Insertion sort...
count 15372
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 56
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

...Insertion sort...

count 67408

Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 61  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101



```
...Insertion sort...
count 248966
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
...Insertion sort...
count 4024739
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 76
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

...Insertion sort...  
count 16014588  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 81  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101

...Insertion sort...  
count 64403841  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 86  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101

Merge Sort  
count 384  
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
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50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64

Merge Sort  
count 160  
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32

terminated  
Merge Sort  
count 64  
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16

Merge Sort  
count 24  
1  
2  
3  
4  
5  
6  
7  
8

Merge Sort

count 896

Sorted [50] = 51  
Sorted [51] = 51  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101

Merge Sort

count 2048

Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 56  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101

Merge Sort  
count 4608  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 61  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101



```
Merge Sort
count 10240
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

Merge Sort  
count 22528  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 71  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101

Merge Sort

count 49152

Sorted [50] = 51

Sorted [51] = 52

Sorted [52] = 53

Sorted [53] = 54

Sorted [54] = 55

Sorted [55] = 56

Sorted [56] = 57

Sorted [57] = 58

Sorted [58] = 59

Sorted [59] = 60

Sorted [60] = 61

Sorted [61] = 62

Sorted [62] = 63

Sorted [63] = 64

Sorted [64] = 65

Sorted [65] = 66

Sorted [66] = 67

Sorted [67] = 68

Sorted [68] = 69

Sorted [69] = 70

Sorted [70] = 71

Sorted [71] = 72

Sorted [72] = 73

Sorted [73] = 74

Sorted [74] = 75

Sorted [75] = 76

Sorted [76] = 76

Sorted [77] = 78

Sorted [78] = 79

Sorted [79] = 80

Sorted [80] = 81

Sorted [81] = 82

Sorted [82] = 83

Sorted [83] = 84

Sorted [84] = 85

Sorted [85] = 86

Sorted [86] = 87

Sorted [87] = 88

Sorted [88] = 89

Sorted [89] = 90

Sorted [90] = 91

Sorted [91] = 92

Sorted [92] = 93

Sorted [93] = 94

Sorted [94] = 95

Sorted [95] = 96

Sorted [96] = 97

Sorted [97] = 98

Sorted [98] = 99

Sorted [99] = 100

Sorted [100] = 101

## Merge Sort

```
count 106496
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 81
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

Merge Sort  
count 229376  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 86  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101

.... Heap Sort....

count 331

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64

.... Heap Sort..

count 140

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32

.... Heap Sort....

count 49

2  
1  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16

.... Heap Sort....

count 17

2  
1  
3  
4  
5  
6  
7  
8

.... Heap Sort....

count 794

Sorted [50] = 51  
Sorted [51] = 51  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101

```
.... Heap Sort....  
count 4133  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 61  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101
```



.... Heap Sort....

count 4133

Sorted [50] = 51

Sorted [51] = 52

Sorted [52] = 53

Sorted [53] = 54

Sorted [54] = 55

Sorted [55] = 56

Sorted [56] = 57

Sorted [57] = 58

Sorted [58] = 59

Sorted [59] = 60

Sorted [60] = 61

Sorted [61] = 61

Sorted [62] = 63

Sorted [63] = 64

Sorted [64] = 65

Sorted [65] = 66

Sorted [66] = 67

Sorted [67] = 68

Sorted [68] = 69

Sorted [69] = 70

Sorted [70] = 71

Sorted [71] = 72

Sorted [72] = 73

Sorted [73] = 74

Sorted [74] = 75

Sorted [75] = 76

Sorted [76] = 77

Sorted [77] = 78

Sorted [78] = 79

Sorted [79] = 80

Sorted [80] = 81

Sorted [81] = 82

Sorted [82] = 83

Sorted [83] = 84

Sorted [84] = 85

Sorted [85] = 86

Sorted [86] = 87

Sorted [87] = 88

Sorted [88] = 89

Sorted [89] = 90

Sorted [90] = 91

Sorted [91] = 92

Sorted [92] = 93

Sorted [93] = 94

Sorted [94] = 95

Sorted [95] = 96

Sorted [96] = 97

Sorted [97] = 98

Sorted [98] = 99

Sorted [99] = 100

Sorted [100] = 101

```
.... Heap Sort....  
count 9422  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101
```

```
.... Heap Sort....  
count 20805  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 71  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 87  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101
```

```
.... Heap Sort....
count 45677
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 76
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
.... Heap Sort....
count 99548
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 81
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
.... Heap Sort....  
count 215391  
Sorted [50] = 51  
Sorted [51] = 52  
Sorted [52] = 53  
Sorted [53] = 54  
Sorted [54] = 55  
Sorted [55] = 56  
Sorted [56] = 57  
Sorted [57] = 58  
Sorted [58] = 59  
Sorted [59] = 60  
Sorted [60] = 61  
Sorted [61] = 62  
Sorted [62] = 63  
Sorted [63] = 64  
Sorted [64] = 65  
Sorted [65] = 66  
Sorted [66] = 67  
Sorted [67] = 68  
Sorted [68] = 69  
Sorted [69] = 70  
Sorted [70] = 71  
Sorted [71] = 72  
Sorted [72] = 73  
Sorted [73] = 74  
Sorted [74] = 75  
Sorted [75] = 76  
Sorted [76] = 77  
Sorted [77] = 78  
Sorted [78] = 79  
Sorted [79] = 80  
Sorted [80] = 81  
Sorted [81] = 82  
Sorted [82] = 83  
Sorted [83] = 84  
Sorted [84] = 85  
Sorted [85] = 86  
Sorted [86] = 86  
Sorted [87] = 88  
Sorted [88] = 89  
Sorted [89] = 90  
Sorted [90] = 91  
Sorted [91] = 92  
Sorted [92] = 93  
Sorted [93] = 94  
Sorted [94] = 95  
Sorted [95] = 96  
Sorted [96] = 97  
Sorted [97] = 98  
Sorted [98] = 99  
Sorted [99] = 100  
Sorted [100] = 101
```

.... QuickSort....

count 394

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64

.... QuickSort....

count 123

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32

.... QuickSort....

count 55

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16

.... QuickSort....

count 16

1  
2  
3  
4  
5  
6  
7  
8

.... QuickSort....

count 901

Sorted [50] = 51

Sorted [51] = 51

Sorted [52] = 53

Sorted [53] = 54

Sorted [54] = 55

Sorted [55] = 56

Sorted [56] = 57

Sorted [57] = 58

Sorted [58] = 59

Sorted [59] = 60

Sorted [60] = 61

Sorted [61] = 62

Sorted [62] = 63

Sorted [63] = 64

Sorted [64] = 65

Sorted [65] = 66

Sorted [66] = 67

Sorted [67] = 68

Sorted [68] = 69

Sorted [69] = 70

Sorted [70] = 71

Sorted [71] = 72

Sorted [72] = 73

Sorted [73] = 74

Sorted [74] = 75

Sorted [75] = 76

Sorted [76] = 77

Sorted [77] = 78

Sorted [78] = 79

Sorted [79] = 80

Sorted [80] = 81

Sorted [81] = 82

Sorted [82] = 83

Sorted [83] = 84

Sorted [84] = 85

Sorted [85] = 86

Sorted [86] = 87

Sorted [87] = 88

Sorted [88] = 89

Sorted [89] = 90

Sorted [90] = 91

Sorted [91] = 92

Sorted [92] = 93

Sorted [93] = 94

Sorted [94] = 95

Sorted [95] = 96

Sorted [96] = 97

Sorted [97] = 98

Sorted [98] = 99

Sorted [99] = 100

Sorted [100] = 101



```
.... QuickSort....
count 2123
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 56
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
.... QuickSort....
count 4873
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 61
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
... QuickSort...
count 11049
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
.... QuickSort....
count 24573
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 71
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
.... QuickSort....
count 54225
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 76
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
.... QuickSort....
count 128095
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 81
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 87
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

```
... QuickSort....
count 285822
Sorted [50] = 51
Sorted [51] = 52
Sorted [52] = 53
Sorted [53] = 54
Sorted [54] = 55
Sorted [55] = 56
Sorted [56] = 57
Sorted [57] = 58
Sorted [58] = 59
Sorted [59] = 60
Sorted [60] = 61
Sorted [61] = 62
Sorted [62] = 63
Sorted [63] = 64
Sorted [64] = 65
Sorted [65] = 66
Sorted [66] = 67
Sorted [67] = 68
Sorted [68] = 69
Sorted [69] = 70
Sorted [70] = 71
Sorted [71] = 72
Sorted [72] = 73
Sorted [73] = 74
Sorted [74] = 75
Sorted [75] = 76
Sorted [76] = 77
Sorted [77] = 78
Sorted [78] = 79
Sorted [79] = 80
Sorted [80] = 81
Sorted [81] = 82
Sorted [82] = 83
Sorted [83] = 84
Sorted [84] = 85
Sorted [85] = 86
Sorted [86] = 86
Sorted [87] = 88
Sorted [88] = 89
Sorted [89] = 90
Sorted [90] = 91
Sorted [91] = 92
Sorted [92] = 93
Sorted [93] = 94
Sorted [94] = 95
Sorted [95] = 96
Sorted [96] = 97
Sorted [97] = 98
Sorted [98] = 99
Sorted [99] = 100
Sorted [100] = 101
```

### Analysis:

After observing the test case summary table, I came to conclusion that the slowest sorting algorithm among four of them was "Insertion Sort". Also, it can be seen that Merge Sort and Heap Sort are preferable compared to insertion sort because it has least number of steps and fastest run time as well. I donot think that sorting algorithm really takes  $O(n^2)$  or  $O(n \log n)$  running time. But Merge Sort is an exception where it always takes  $O(n \log n)$  time to run. In class we had learnt that the worst case run time of Insertion Sort is  $O(n^2)$ , and the best case is  $O(n)$ . After the experiment is performed, we can see that Insertion Sort takes less time than  $O(n^2)$  in average case. But if we compare with other algorithms it takes the longest run time. For Quick Sort, depending on the location of the pivot takes  $O(n \log n)$  in average and  $O(n^2)$  in worst case. Observing the steps in the experiment, we can see Quick Sort had the average case run time of  $O(n \log n)$  where as, Merge Sort, in both theoritical and practical takes exact run time of  $O(n \log n)$ .

Insertion Sort takes the most steps and Quick Sort takes the most steps in  $O(n \log n)$  sorts. It is because the worst case runtime of Quick Sort is  $O(n^2)$ . If the array is sorted, I would prefer Insertion Sort since it has  $O(n)$  runtime. And, If we know the partition is balance I would prefer Quick Sort. Also, in general Heap Sort seems preferable as it has the least number of steps. Even though Heap Sort is typically slower than Quick Sort, the worst case runtime of Heap Sort is  $O(n \log n)$  comparing to Quick Sort's  $O(n^2)$ .