DSA I Lab 6: Sorts

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Abstract. The experiment investigated implementation and runtimes of the generic-type and Comparable-inherited sorting algorithms bubbleSort, insertSort, mergeSort, and quickSort through four experiments that emphasized. The lab concludes that, unless the data set involves numbers that are “almost-sorted” or the threshold of disorderliness is exceptionally low, the quick sort is the fastest sort. Otherwise, insertion sort is the fastest sort.

Keywords: bubbleSort, mergeSort, quickSort, insertSort, Java, Lists

The lab explored the efficiency of different sorts in Java through testing the sorts in four experiments.

1.1 Experiment One

Experiment One runs an array with a set of random values through each sort method and is times. Quicksort or mergeSort is expected to run the fastest due to their big theta *nlog(n)* runtimes.

```
//Experiment One Example Test Code:
      //BUBBLE SORT TESTING
//Starting timer
t = (int) System.currentTimeMillis();
//Sorting list
bubbleSort(bub);
//Recording Time
time = ((int) System.currentTimeMillis()) - t;
b.add(time);
```

1.2 Experiment Two

Experiment Two runs through same procedure as the first experiment except the lists generated are sorted reversely. The same results are expected.

1.3 Experiment Three

Experiment three runs each list through an algorithm that's almost sorted. The same results are expected although there is the possibility of insertion sort running faster in this specific experiment due to its ability to adjust small errors in unsorted lists more quickly than the other sorts.

1.4 Experiment Four

Experiment Four implements a hybrid sort that switches algorithms mid experiment to optimize runtimes based on the results of the previous experiments. The hybrid sort takes the size of the array left and deduces which sort to use.

```
//Experiment Four
        private static <T extends Comparable<T>> void
hybridSort(T[] list){
                        hybridSort(list, 0, list.length - 1);
                }
                private static <T extends Comparable<T>> void
hybridSort(T[] list, int i, int j){
                        if(j - i < 1000)
                        {
                                insertionSort(list);
                        }
                        else
                        {
                                quickSortH(list, i , j);
                        }

                }
```

2 Experiment:

The procedure for the experiment runs through numerous trials of that sort methods using various data sets, recording the runtime of the sorts. The average and standard deviation of the trials will be calculated and recorded. The data will be analyzed based on the trial's runtimes, averages, and standard deviations. The experiment table lists the number of trials, runs, and additional information regarding the experimental procedure.

2.1 Experiment Table:

	Exp. 1	**Exp. 2**	**Exp. 3**	**Exp. 4**
No. of Trials	10	10	10	10
Number of Elements in List	10,000	10,000	10,000	10,000

3 Results

3.1 Table Results

Experiment One:

Trials	bubbleSort	insertionSort	mergeSort	quickSort
1	525	148	213	6
2	314	113	139	18
3	273	65	39	2
4	257	67	140	1
5	266	68	38	1
6	275	63	38	2
7	347	64	317	2
8	261	92	36	1
9	299	67	50	2
10	256	63	21	1
Average	307.3	81	103.1	2
Standard Deviation	81.8630971	28.6511586	98.39201639	5.274677452

Experiment Two:

Trials	bubbleSort	insertionSort	mergeSort	quickSort
1	449	187	198	75
2	333	137	120	34
3	358	98	38	21
4	364	96	151	22
5	346	68	27	16
6	325	72	52	16
7	331	89	155	14
8	338	72	29	23
9	341	77	26	16
10	216	80	27	1

Average	340.1	97.6	82.3	2
Standard Deviation	56.3253446	37.33095231	66.51658106	19.82030384

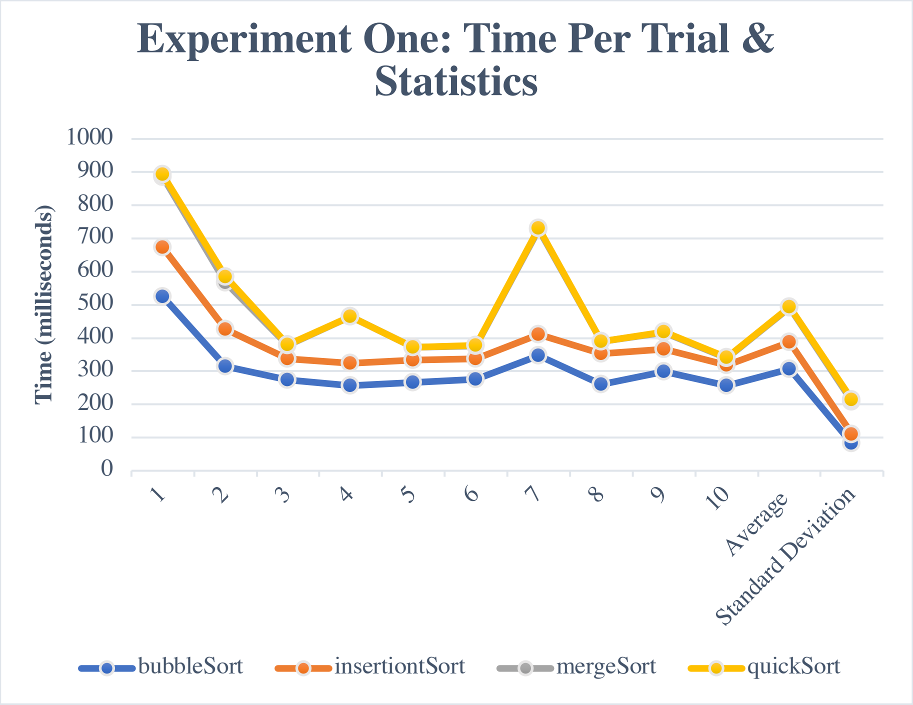
Experiment Three:

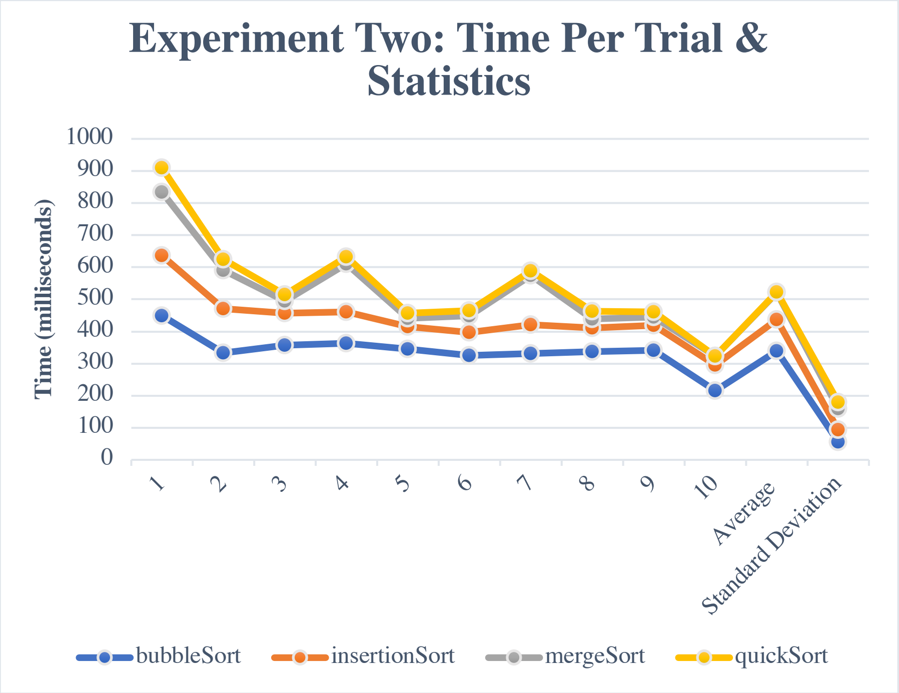
Trials	bubbleSort	insertionSort	mergeSort	quickSort
1	353	176	145	136
2	330	134	131	96
3	169	69	27	91
4	176	67	117	92
5	178	73	44	104
6	206	86	166	112
7	214	86	26	91
8	250	89	33	93
9	178	99	21	142
10	216	99	40	99
Average	227	97.8	75	105.6
Standard Deviation	65.41491505	33.62803064	57.39918699	18.8514662

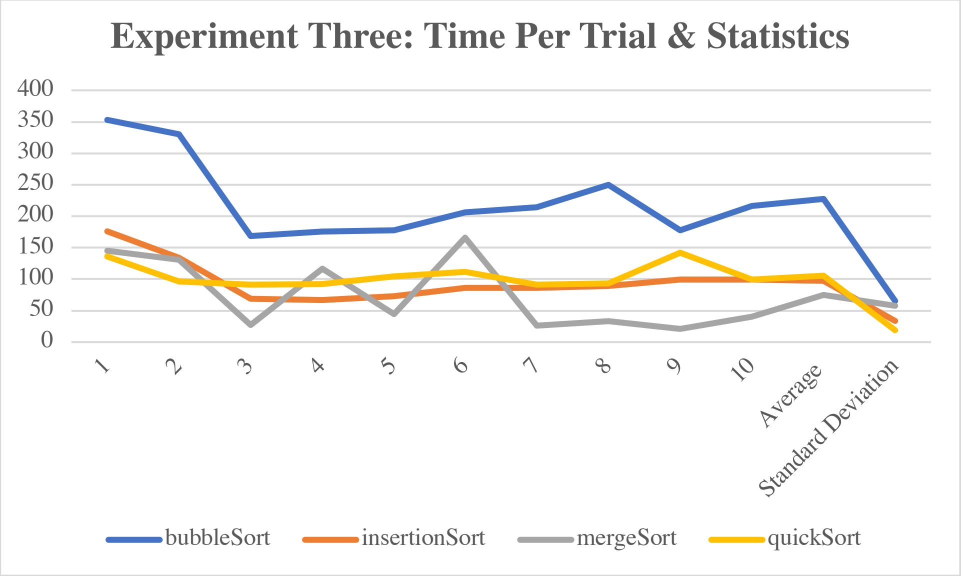
Experiment Four: Trials	Exp. 1	Exp. 2	Exp. 2
1	353	576	775
2	330	634	731
3	469	669	827
4	476	767	617
5	578	873	844
6	106	386	666
7	324	486	726
8	420	589	533
9	148	699	321

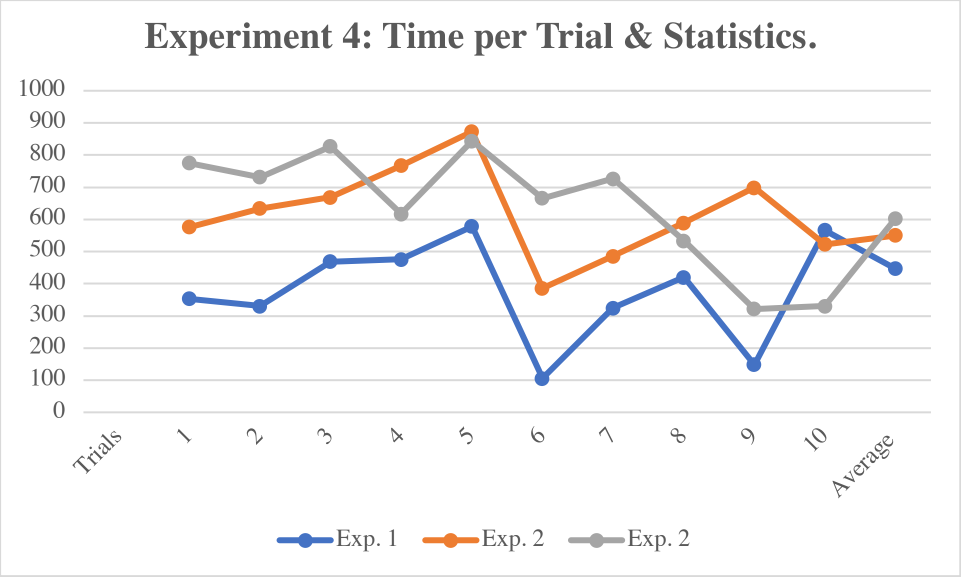
10	566	522	330
Average	447	550.4	603

3.2 Graph Results




Experiment Two: Time Per Trial & Statistics
Time (milliseconds)
1000
900
800
700
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
9
10
Average
Standard Deviation
bubbleSort
insertionSort
mergeSort
quickSort


Experiment Three: Time Per Trial & Statistics
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
Average
Standard Deviation
bubbleSort
insertionSort
mergeSort
quickSort



4 Conclusion

The experiment tested the runtimes of sorts through various experiments. The first experiment, implementing sorts on large lists of random integers, demonstrated quick sort as the fastest sort method and bubble sort as the slowest. While both the quick and bubble sorts having similar runtimes, quick sort shows to be better suited for smaller datasets. The second experiment is identical to the first but the data set given is in reverse sorted order. The results show that the quick sort ran the fastest. The third experiment is implemented the same as the previous two but with a data set that's almost sorted. The results demonstrate that the quick sort ran the fastest. The fourth experiment creates a hybrid sort that attempts to move more quickly than the sorts already implemented by combining some of them into a new sort. The hybrid sort's runtime was overall, slower than the sorts that comprise it. Errors include faulty coding and testing. Future experiments could implement known or other unmade hybrid sorts and compare their runtimes.