

Script started on 2021-02-23 20:58:39-0600

l_ludios@ares:~\$ cat AlgoAnalysis.info

/*****

```
*
*
* NAME:  Leia Ludios                      CLASS:  CSC121-W01
*
*
* Assignment: Lab P-4.62                  Level:   2
*
*
* Description:
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*
* P-4.62: Perform an experimental analysis to test the hypothesis that
*
* Java's array sort method runs on  $O(n \log n)$  time on average.
*
*
* Answer based on analysis:
*
* The Array.sort has a runtime that's less than or equal to
*
* the growth of the reference function  $n \log n$ . We could say
*
* that the .sort method has a runtime that's  $O(n \log(n))$  as  $n$  reaches
*
* infinity.
*
*
* *****/
```

l_ludios@ares:~\$ cat AnalysisMain.java

```
import java.util.Arrays;
import java.util.Random;
import java.lang.Math;
public class AnalysisMain {
    public static void main(String[] args) {

        int sizeOfArray = 500;
        int[] integerArr = new int[sizeOfArray];
```

```
        System.out.println("Size of Array: " + sizeOfArray);
        Random generator = new Random();
        for(int i = 0; i < sizeOfArray; i++) {
            integerArr[i] = generator.nextInt(sizeOfArray)+1;
        }
    }
```

```
    for(int j = 20; j != 0; j--) {
        long start = System.currentTimeMillis();
        Arrays.sort(integerArr);
        long end = System.currentTimeMillis();

        long elapsed = end - start;

        System.out.println("Time to accomplish sort: " + elapsed + " milliseconds'

        //linearithmic  $O(n \log n)$  time
        long referenceFunction = (long)sizeOfArray * (long)Math.log(sizeOfArray);

        System.out.println("Reference Func Value: " + referenceFunction);
        double ratio;
        if(elapsed != 0)
            ratio = ((double)elapsed)/referenceFunction;
        else {
            ratio = 0;
        }

        System.out.println("Ratio (Reference function:Elapsed time): " + ratio);

        if(j -1 !=0) {
            sizeOfArray *= 2;
            integerArr = new int[sizeOfArray];
            System.out.println("\n\nSize of Array: " + sizeOfArray);

        }
        for(int k = 0; k < sizeOfArray; k++) {
            integerArr[k] = generator.nextInt(sizeOfArray) + 1;
        }
    }
}
```

l_ludios@ares:~\$ javac AnalysisMain.java

l_ludios@ares:~\$ java AnalysisMain

Size of Array: 500

Time to accomplish sort: 0 milliseconds

Reference Func Value: 3000

Ratio (Reference function:Elapsed time): 0.0

Size of Array: 1000

Time to accomplish sort: 1 milliseconds

Reference Func Value: 6000

Ratio (Reference function:Elapsed time): 1.6666666666666666E-4

Size of Array: 2000
Time to accomplish sort: 1 milliseconds
Reference Func Value: 14000
Ratio (Reference function:Elapsed time): 7.142857142857143E-5

Size of Array: 4000
Time to accomplish sort: 2 milliseconds
Reference Func Value: 32000
Ratio (Reference function:Elapsed time): 6.25E-5

Size of Array: 8000
Time to accomplish sort: 1 milliseconds
Reference Func Value: 64000
Ratio (Reference function:Elapsed time): 1.5625E-5

Size of Array: 16000
Time to accomplish sort: 1 milliseconds
Reference Func Value: 144000
Ratio (Reference function:Elapsed time): 6.944444444444445E-6

Size of Array: 32000
Time to accomplish sort: 3 milliseconds
Reference Func Value: 320000
Ratio (Reference function:Elapsed time): 9.375E-6

Size of Array: 64000
Time to accomplish sort: 7 milliseconds
Reference Func Value: 704000
Ratio (Reference function:Elapsed time): 9.943181818181819E-6

Size of Array: 128000
Time to accomplish sort: 16 milliseconds
Reference Func Value: 1408000
Ratio (Reference function:Elapsed time): 1.1363636363636363E-5

Size of Array: 256000
Time to accomplish sort: 33 milliseconds
Reference Func Value: 3072000
Ratio (Reference function:Elapsed time): 1.07421875E-5

Size of Array: 512000
Time to accomplish sort: 98 milliseconds
Reference Func Value: 6656000
Ratio (Reference function:Elapsed time): 1.4723557692307692E-5

Size of Array: 1024000
Time to accomplish sort: 87 milliseconds
Reference Func Value: 13312000
Ratio (Reference function:Elapsed time): 6.535456730769231E-6

Size of Array: 2048000
Time to accomplish sort: 184 milliseconds
Reference Func Value: 28672000
Ratio (Reference function:Elapsed time): 6.417410714285715E-6

Size of Array: 4096000
Time to accomplish sort: 381 milliseconds
Reference Func Value: 61440000
Ratio (Reference function:Elapsed time): 6.201171875E-6

Size of Array: 8192000
Time to accomplish sort: 799 milliseconds
Reference Func Value: 122880000
Ratio (Reference function:Elapsed time): 6.502278645833333E-6

Size of Array: 16384000
Time to accomplish sort: 1670 milliseconds
Reference Func Value: 262144000
Ratio (Reference function:Elapsed time): 6.37054443359375E-6

Size of Array: 32768000
Time to accomplish sort: 3479 milliseconds
Reference Func Value: 557056000
Ratio (Reference function:Elapsed time): 6.245332605698529E-6

Size of Array: 65536000
Time to accomplish sort: 7304 milliseconds
Reference Func Value: 1114112000
Ratio (Reference function:Elapsed time): 6.555893841911765E-6

Size of Array: 131072000
Time to accomplish sort: 15137 milliseconds
Reference Func Value: 2359296000
Ratio (Reference function:Elapsed time): 6.415896945529514E-6

Size of Array: 262144000
Time to accomplish sort: 31703 milliseconds
Reference Func Value: 4980736000
Ratio (Reference function:Elapsed time): 6.365123548005757E-6

l_ludios@ares:~\$
l_ludios@ares:~\$ cat output.txt

//data used in the visual.

Size of Array: 200
Time to accomplish sort: 1 milliseconds
Reference Func Value: 1000
Ratio (Reference function:Elapsed time): 0.001

Size of Array: 400
Time to accomplish sort: 0 milliseconds
Reference Func Value: 2000
Ratio (Reference function:Elapsed time): 0.0

Size of Array: 800
Time to accomplish sort: 1 milliseconds
Reference Func Value: 4800
Ratio (Reference function:Elapsed time): 2.083333333333335E-4

Size of Array: 1600
Time to accomplish sort: 1 milliseconds
Reference Func Value: 11200
Ratio (Reference function:Elapsed time): 8.928571428571429E-5

Size of Array: 3200
Time to accomplish sort: 2 milliseconds
Reference Func Value: 25600
Ratio (Reference function:Elapsed time): 7.8125E-5

Size of Array: 6400
Time to accomplish sort: 1 milliseconds
Reference Func Value: 51200
Ratio (Reference function:Elapsed time): 1.953125E-5

Size of Array: 12800
Time to accomplish sort: 2 milliseconds
Reference Func Value: 115200
Ratio (Reference function:Elapsed time): 1.736111111111111E-5

Size of Array: 25600
Time to accomplish sort: 4 milliseconds
Reference Func Value: 256000
Ratio (Reference function:Elapsed time): 1.5625E-5

Size of Array: 51200

Time to accomplish sort: 8 milliseconds
Reference Func Value: 512000
Ratio (Reference function:Elapsed time): 1.5625E-5

Size of Array: 102400
Time to accomplish sort: 15 milliseconds
Reference Func Value: 1126400
Ratio (Reference function:Elapsed time): 1.3316761363636363E-5

Size of Array: 204800
Time to accomplish sort: 41 milliseconds
Reference Func Value: 2457600
Ratio (Reference function:Elapsed time): 1.6682942708333332E-5

Size of Array: 409600
Time to accomplish sort: 77 milliseconds
Reference Func Value: 4915200
Ratio (Reference function:Elapsed time): 1.5665690104166666E-5

Size of Array: 819200
Time to accomplish sort: 66 milliseconds
Reference Func Value: 10649600
Ratio (Reference function:Elapsed time): 6.197415865384615E-6

Size of Array: 1638400
Time to accomplish sort: 142 milliseconds
Reference Func Value: 22937600
Ratio (Reference function:Elapsed time): 6.1907087053571425E-6

Size of Array: 3276800
Time to accomplish sort: 295 milliseconds
Reference Func Value: 49152000
Ratio (Reference function:Elapsed time): 6.001790364583333E-6

Size of Array: 6553600
Time to accomplish sort: 576 milliseconds
Reference Func Value: 98304000
Ratio (Reference function:Elapsed time): 5.859375E-6

Size of Array: 13107200
Time to accomplish sort: 1125 milliseconds
Reference Func Value: 209715200
Ratio (Reference function:Elapsed time): 5.364418029785156E-6

Size of Array: 26214400

Time to accomplish sort: 2359 milliseconds
Reference Func Value: 445644800
Ratio (Reference function:Elapsed time): 5.293453440946691E-6

Size of Array: 52428800
Time to accomplish sort: 4877 milliseconds
Reference Func Value: 891289600
Ratio (Reference function:Elapsed time): 5.47184663660386E-6

Size of Array: 104857600
Time to accomplish sort: 10221 milliseconds
Reference Func Value: 1887436800
Ratio (Reference function:Elapsed time): 5.41528065999349E-6

l_ludios@ares:~\$ exit
exit

Script done on 2021-02-23 21:00:40-0600