

AP COMPUTER SCIENCE A

SORTING SPEEDS

- 1) Download the files `s_10000.txt`, `s_50000.txt`, `s_100000.txt`, `s_200000.txt`, `s_500000.txt` and `s_1000000.txt` from `canvas.instructure.com`. These files contain lists of random numbers. For example, the first few lines of `s_10000.txt` are:

```
10000
/**/
1055
294
593
.
.
.
```

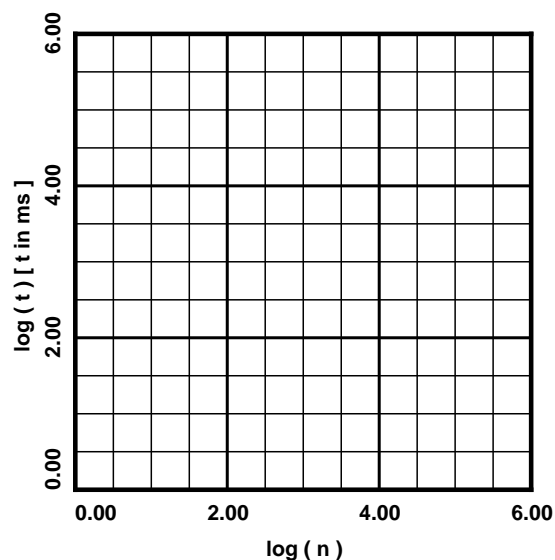
The first two lines just tell the reading program that `s_10000.txt` contains a list of 10,000 numbers (the numbers between 0 and 9999, inclusive) ordered randomly. The third and subsequent lines are the random numbers.

- 2) Download the file `SelectionSort.java` from `canvas.instructure.com`, which performs a min-sort, *i.e.*, a selection sort, on a list of integers. The program `SelectionSort.java` also needs the files `FileInput.java` and `FileOutput.java`, which you may download (if you don't already have them). Compile and run `SelectionSort` and fill out the table below. The program will print out the time, in milliseconds, that it took to perform the sort.

n	t (ms)	$\log n$	$\log t$
10 000			
50 000			
100 000			
200 000			

As was discussed in lecture, the time required to perform a selection sort is $t \sim O(n^2)$, or $t \approx n^2$. Taking the common logarithm of both sides then gives $\log t \approx 2 \log n$. Thus, the points in the above table, when plotted, should follow $\log t = a \cdot \log n + b$, where $a \approx 2$.

- 3) Graph the points in the table at lower left on the axes provided.



- 4) Perform a linear regression on the plotted points to obtain the best-fit equation $\log t = a \cdot \log n + b$, and graph the best-fit line on the axes above.

$$a = ?$$

$$b = ?$$

- 5) Is a close to 2?

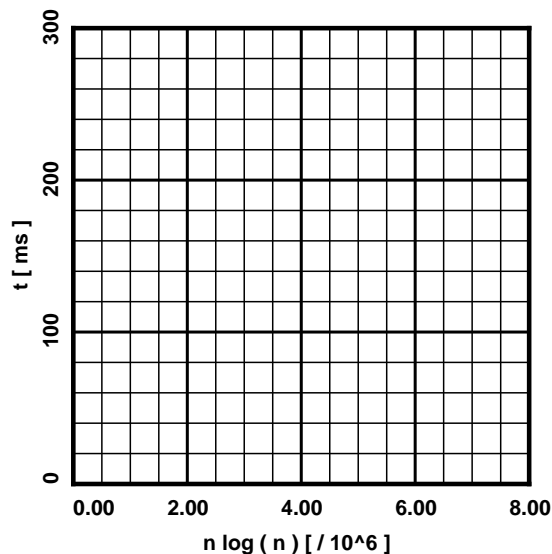
- 6) Download the file `MergeSort.java` from `canvas.instructure.com`, which performs a merge sort on a list of integers. The program `MergeSort.java` also needs the files `FileInput.java` and `FileOutput.java`. In any case, compile and run `MergeSort` and fill out the table below.

n	t (ms)	$n \log n$
10 000		
50 000		
100 000		
500 000		
1 000 000		

- 7) For $n = 100,000$, how many times faster is the merge sort than the selection sort?

As discussed in lecture, the speed of a merge sort is $t \sim O(n \log n)$. Thus, the points in the above table, when plotted, should follow $t = a \cdot n \log n + b$.

- 8) Graph the points in the above table on the axes provided.



- 9) Perform a linear regression on the plotted points to obtain the equation of best fit $t = a \cdot n \log n + b$ and graph the best-fit line on the axes at lower left.

$$a = ?$$

$$b = ?$$