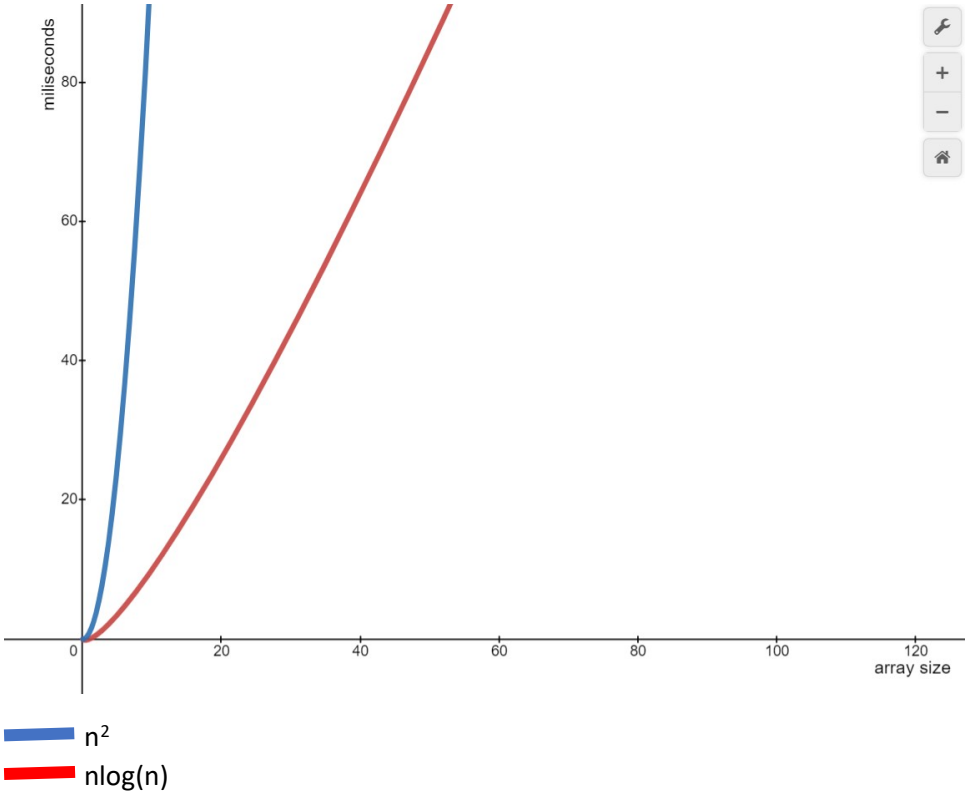
In this project, three algorithms are examined and their expected runtime data are compared to actual runtime of algorithms with different size of arrays within range of 50,000 to 500,000. The algorithms for finding the median of randomly sorted array. Big Oh notation for the algorithms are:

Algorithm 1: $O(n^2)$

Algorithm 2: O(nlog(n))

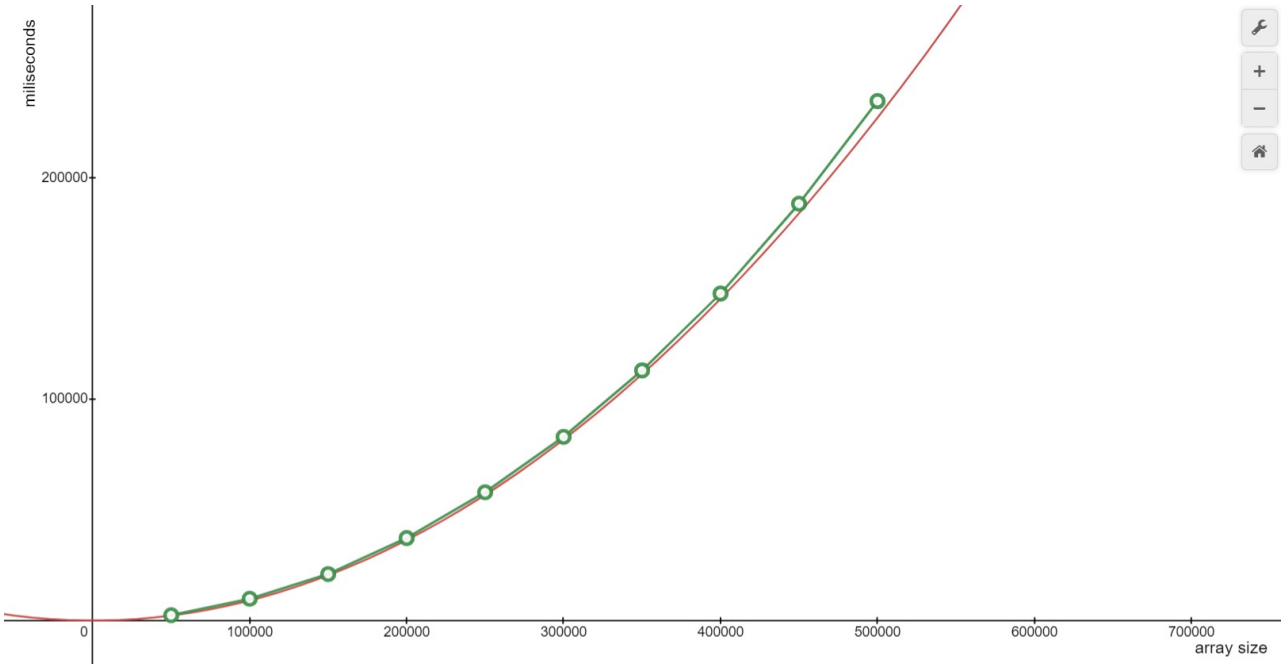
Algorithm 3: O(nlog(n))

Plot 1 (n^2 & nlog(n))



Expected growth rate for first algorithm's runtime is n^2. This is because the algorithm iterates through the n items for n/2 times. Runtimes are matches to expected growth rate graph. The expected graph is $n^2/1{,}000{,}000$

Plot 2 (Algorithm 1 and its runtime)

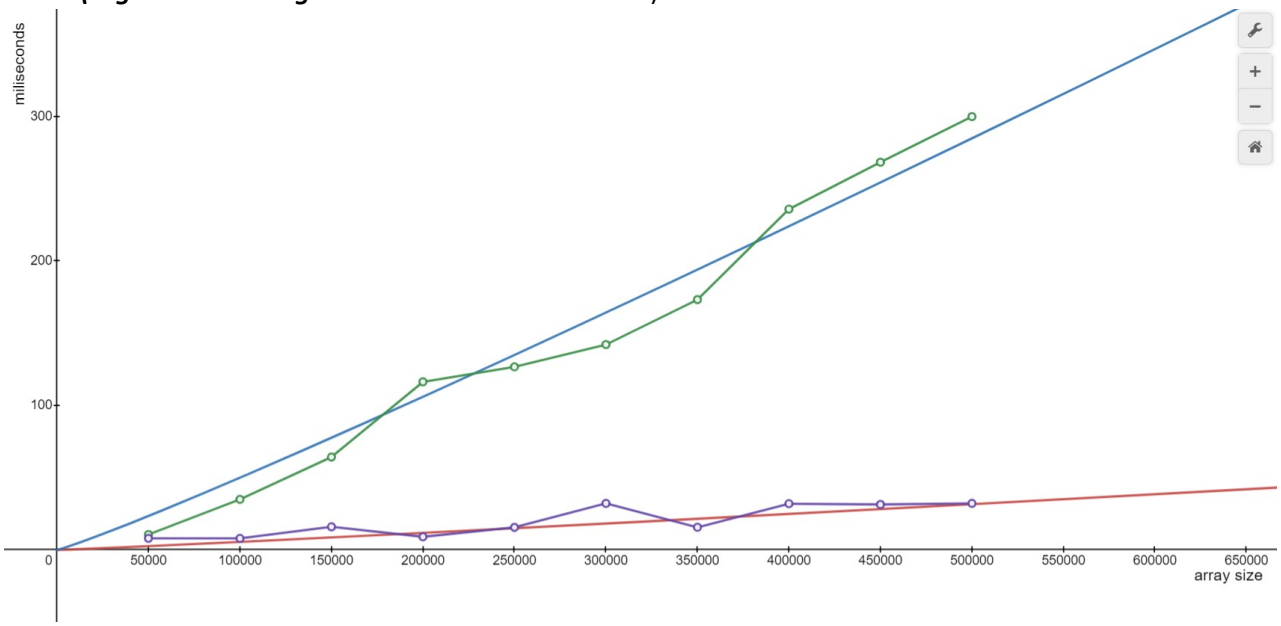


Expected runtime

Actual runtime

Expected growth rate for the algorithm 2 and 3 is nlog(n). They use divide and conquer approach to the problem. The difference between these two growth rates are quite much. Even for arrays with 20 items, it can be clearly seen there is approximately 15 times difference between these two plot. Runtimes are matches to expected growth rate graph. The expected graph for algorithm 2 is nlog(n)/10,000. The expected graph for algorithm 3 is nlog(n)/90,000.

Plot 3 (Algorithm 2 & Algorithm 3 and their runtimes)



Expected runtime of algorithm 2

Expected runtime of algorithm 3

Actual runtime of algorithm 2

Actual runtime of algorithm 3

Table of runtime (miliseconds)

Array Size	Algorithm 1 runtime(ms)	Algorithm 2 runtime(ms)	Algorithm 3 runtime(ms)
50,000	2434.27	10.6411	8.0095
100,000	9874	35	8
150,000	21025.9	64.3151	16.0092
200,000	37304.4	116.382	9.1016
250,000	57999.1	126.748	15.6273
300,000	83044.4	142.169	32.2312
350,000	113057	173.304	15.678
400,000	147814	235.948	31.9849
450,000	188434	268.394	31.472
500,000	234815	299.992	32.2177

Basic Computer Specs

The screenshots of the console(differs by array sizes which are provided from user). Besides, it can be seen that in the last two picture, there is runtime difference even though algorithms are the same and computer is the same. The reason for that is plugging on and changing performance settings of the machine.

```
ENTER SIZE
50000
Execution took 2434.27 milliseconds.
Execution took 10.6411 milliseconds.
Execution took 8.0095 milliseconds.

Process returned 0 (0x0)   execution time : 4.849 s
Press any key to continue.
```

```
ENTER SIZE
100000
Execution took 9874 milliseconds.
Execution took 35 milliseconds.
Execution took 8 milliseconds.

Process returned 0 (0x0)   execution time : 12.521 s
Press any key to continue.
```

```
ENTER SIZE
150000
Execution took 21025.9 milliseconds.
Execution took 64.3151 milliseconds.
Execution took 16.0092 milliseconds.

Process returned 0 (0x0)   execution time : 24.158 s
Press any key to continue.
```

```
ENTER SIZE
200000
Execution took 37304.4 milliseconds.
Execution took 116.382 milliseconds.
Execution took 9.1016 milliseconds.

Process returned 0 (0x0)   execution time : 41.254 s
Press any key to continue.
```

```
ENTER SIZE
250000
Execution took 57999.1 milliseconds.
Execution took 126.748 milliseconds.
Execution took 15.6273 milliseconds.

Process returned 0 (0x0)   execution time : 65.960 s
Press any key to continue.
```

```
ENTER SIZE
300000
Execution took 83044.3 milliseconds.
Execution took 142.169 milliseconds.
Execution took 32.2312 milliseconds.

Process returned 0 (0x0)   execution time : 92.908 s
Press any key to continue.
```

```
ENTER SIZE
350000
Execution took 113057 milliseconds.
Execution took 173.304 milliseconds.
Execution took 15.678 milliseconds.

Process returned 0 (0x0)   execution time : 117.970 s
Press any key to continue.
```

```
ENTER SIZE
400000
Execution took 147814 milliseconds.
Execution took 235.948 milliseconds.
Execution took 31.9849 milliseconds.

Process returned 0 (0x0)   execution time : 152.239 s
Press any key to continue.
```

```
ENTER SIZE
450000
Execution took 188434 milliseconds.
Execution took 268.394 milliseconds.
Execution took 31.472 milliseconds.

Process returned 0 (0x0)   execution time : 192.170 s
Press any key to continue.
```

```
ENTER SIZE
500000
Execution took 234815 milliseconds.
Execution took 299.972 milliseconds.
Execution took 32.2177 milliseconds.

Process returned 0 (0x0)   execution time : 241.446 s
Press any key to continue.
```

```
ENTER SIZE
500000
Execution took 167293 milliseconds.
Execution took 218.726 milliseconds.
Execution took 15.6236 milliseconds.

Process returned 0 (0x0)   execution time : 171.652 s
Press any key to continue.
```