In this project, four algorithms are examined and their expected runtime data are compared to actual runtime of algorithms with different size of arrays within range of 500 to 5,000. Elements for arrays are integers and between [-1000, 1000] interval. Same array is used as input for each algorithm to compare the results fairly. The algorithms' goal is finding the maximum sequence of sum of randomly sorted array. Big Oh notation for the algorithms are:

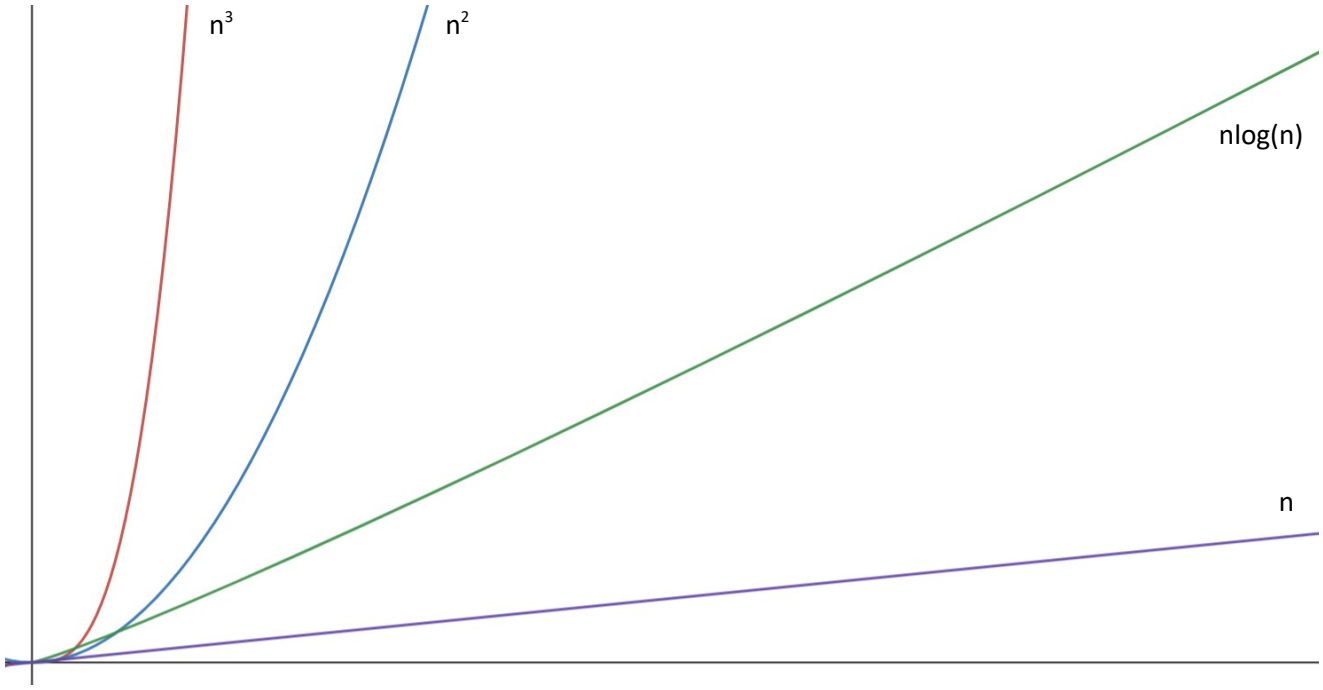
maxSubSum1 function (Algorithm 1): $O(n^3)$

maxSubSum2 function (Algorithm 2): $O(n^2)$

maxSubSum3 function (Algorithm 3): O(nlog(n))

maxSubSum4 function (Algorithm 4): O(n)

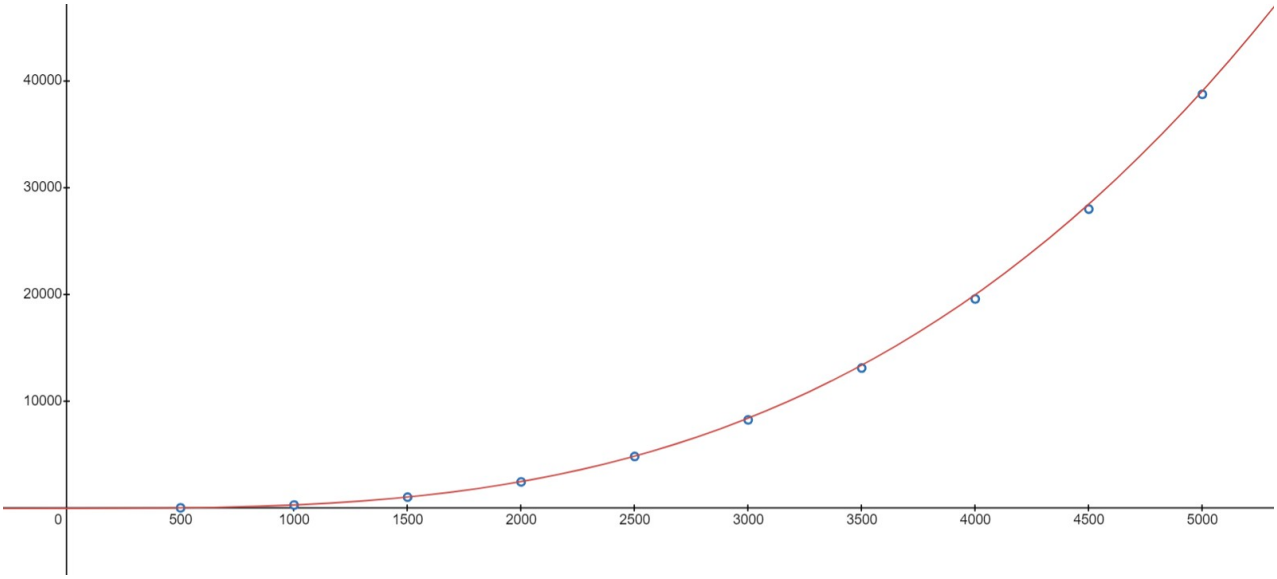
Expected Growth Rates for each Algorithm (n^3 & n^2 & nlog(n) & n)



- Expected growth rate for first algorithm's runtime is n^3. This is because the algorithm iterates through the n elements for 3 times. Runtimes are matches to expected growth rate graph. The expected graph is $n^3/10,000,000$
- Expected growth rate for second algorithm's runtime is n^2. This is because the algorithm iterates through the n elements for 2 times. Runtimes are matches to expected growth rate graph. The expected graph is $n^2/10,000$
- Expected growth rate for third algorithm's runtime is nlog(n). This is because the algorithm iterates through the n elements for n/2 times. Runtimes are matches to expected growth rate graph. The expected graph is nlog(n)/10
- Expected growth rate for fourth algorithm's runtime is n. This is because the algorithm iterates through the n elements for 1 time. Runtimes are matches to expected growth rate graph. The expected graph is n/10

*denominators of numbers are arbitrarily chosen so that the growth rates are easier to understand.

Expected runtime for Algorithm 1 and actual runtime



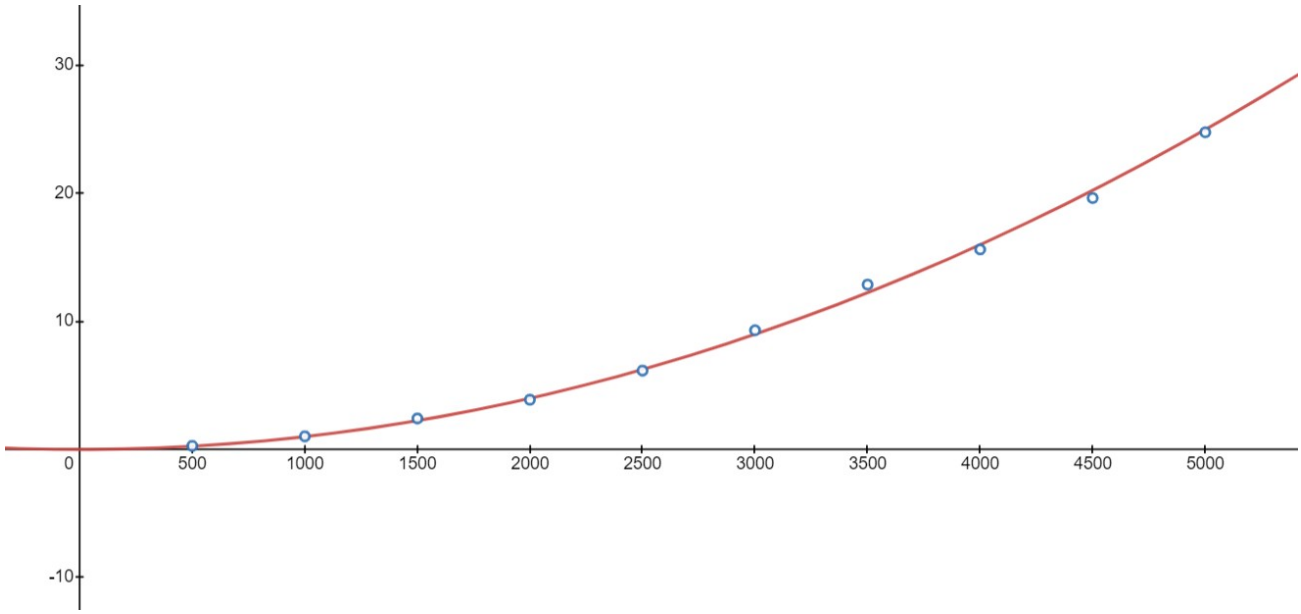
Actual runtime

Expected runtime of algorithm 1

Input Size	Expected Runtime(ms)	Actual Runtime(ms)
500	39.0625	40.5816
1000	312.500	310.918
1500	1054.68	1044.13
2000	2500.00	2468.77
2500	4882.81	4855.13
3000	8437.50	8276.74
3500	13398.4	13127.2
4000	20000.0	19597.3
4500	28476.6	28006.4
5000	39062.5	38755.3

Expected growth rate for the algorithm 1 is n^3. This is clearly the most basic and unefficient solution. Runtimes are matches to expected growth rate graph. The expected graph for algorithm 1 is $n^3/3{,}200{,}000$. Big Oh notation does not indicate the actual runtime. It is used for expecting growth rates of runtimes. The divisor is chosen arbitrarily in order to match with actual runtime.

Expected runtime for Algorithm 2 and actual runtime



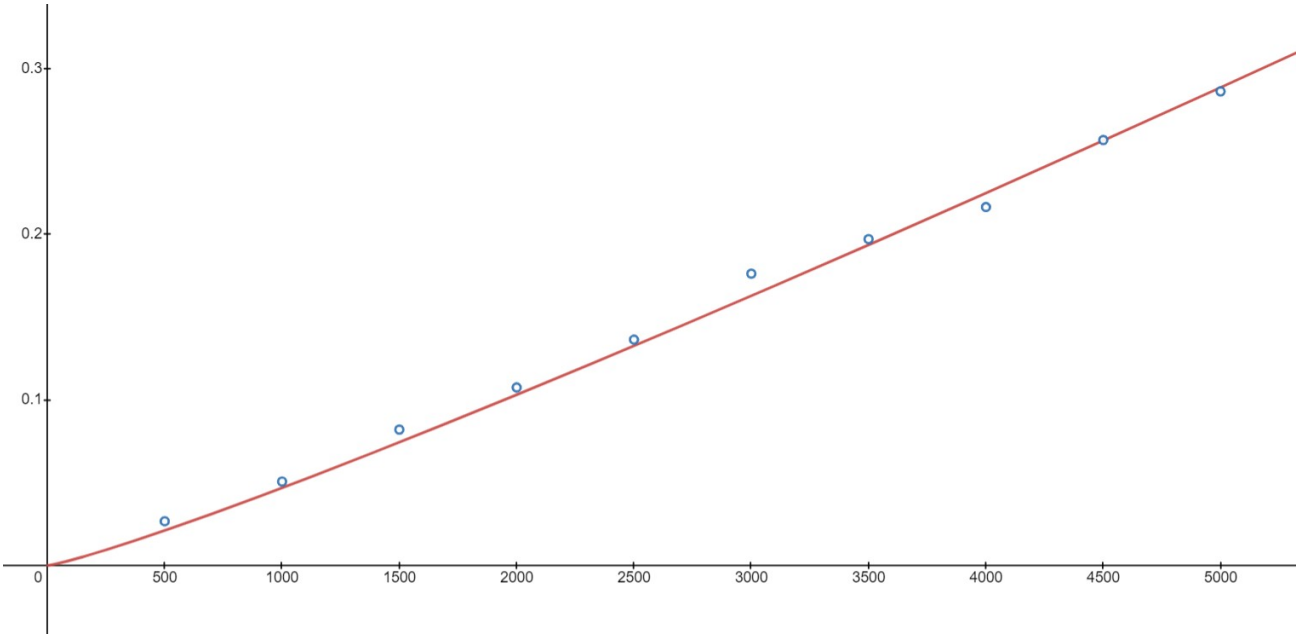
Actual runtime

Expected runtime of algorithm 2

Input Size	Expected Runtime(ms)	Actual Runtime(ms)
500	0.2500	0.2760
1000	1.0000	1.0260
1500	2.2500	2.4233
2000	4.0000	3.8878
2500	6.2500	6.1633
3000	9.0000	9.3147
3500	12.250	12.883
4000	16.000	15.638
4500	20.250	19.657
5000	25.000	24.789

Expected growth rate for the algorithm 2 is n^2. This is also quite basic and unefficient solution. Runtimes are matches to expected growth rate graph. The expected graph for algorithm 2 is $n^3/1{,}000{,}000$. Big Oh notation does not indicate the actual runtime. It is used for expecting growth rates of runtimes. The divisor is chosen arbitrarily in order to match with actual runtime.

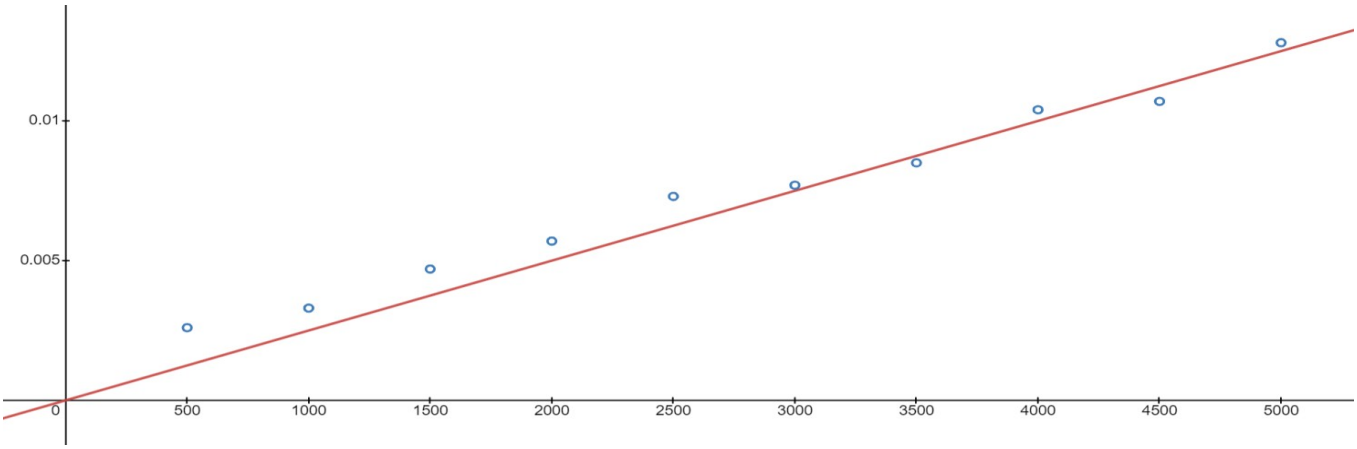
Expected runtime for Algorithm 3 and actual runtime



Input Size	Expected Runtime(ms)	Actual Runtime(ms)
500	0.0210	0.0267
1000	0.0469	0.0507
1500	0.0744	0.0821
2000	0.1031	0.1076
2500	0.1327	0.1365
3000	0.1630	0.1764
3500	0.1938	0.1973
4000	0.2251	0.2167
4500	0.2569	0.2572
5000	0.2890	0.2866

Expected growth rate for the algorithm 3 is nlog(n). This solution uses recursive method to find maximum sub sequence. Runtimes are matches to expected growth rate graph. The expected graph for algorithm 1 is nlog(n)/64,000. Big Oh notation does not indicate the actual runtime. It is used for expecting growth rates of runtimes. The divisor is chosen arbitrarily in order to match with actual runtime.

Expected runtime for Algorithm 4 and actual runtime



Actual runtime

Expected runtime of algorithm 4

Input Size	Expected Runtime(ms)	Actual Runtime(ms)
500	0.0013	0.0026
1000	0.0025	0.0033
1500	0.0038	0.0047
2000	0.0050	0.0057
2500	0.0063	0.0073
3000	0.0075	0.0077
3500	0.0088	0.0085
4000	0.0100	0.0104
4500	0.0113	0.0107
5000	0.0125	0.0128

Expected growth rate for the algorithm 1 is n. This is the best out of four solution. Runtimes are matches to expected growth rate graph. The expected graph for algorithm 1 is n/400,000. Big Oh notation does not indicate the actual runtime. It is used for expecting growth rates of runtimes. The divisor is chosen arbitrarily in order to match with actual runtime.

Basic Computer Specs

Windows edition

Windows 10 Home

System

Manufacturer:	ASUSTeK COMPUTER INC.
Processor:	11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz 3.30 GHz
Installed memory (RAM):	16,0 GB (15,7 GB usable)
System type:	64-bit Operating System, x64-based processor