Project 2 – Collinear Points

By Nicholas Donahue

Estimated Running Time

Brute – The brute class of this project uses a quadruple nested for loop to check each point within that loop against every other point. This is obviously an extremely inefficient and overall slow method (hence the name, 'brute'-force) and is thus reflected in the run time.

Estimated Runtime: $f(x) \sim N^4$

Fast – The fast class of this project utilizes a much more efficient algorithm to determine collinear points. Due to this increased efficiency, the runtime is thus increased. This is similar to a merge sort runtime as it utilizes a double nested for loop to check each point in the first loop to every point thereafter in the second loop. This, combined with the sorting time of the program (limited to O(nlogn) due to Collections.sort()) I can estimate the following runtime.

Estimated Runtime: $f(x) \sim N^2 \log N$

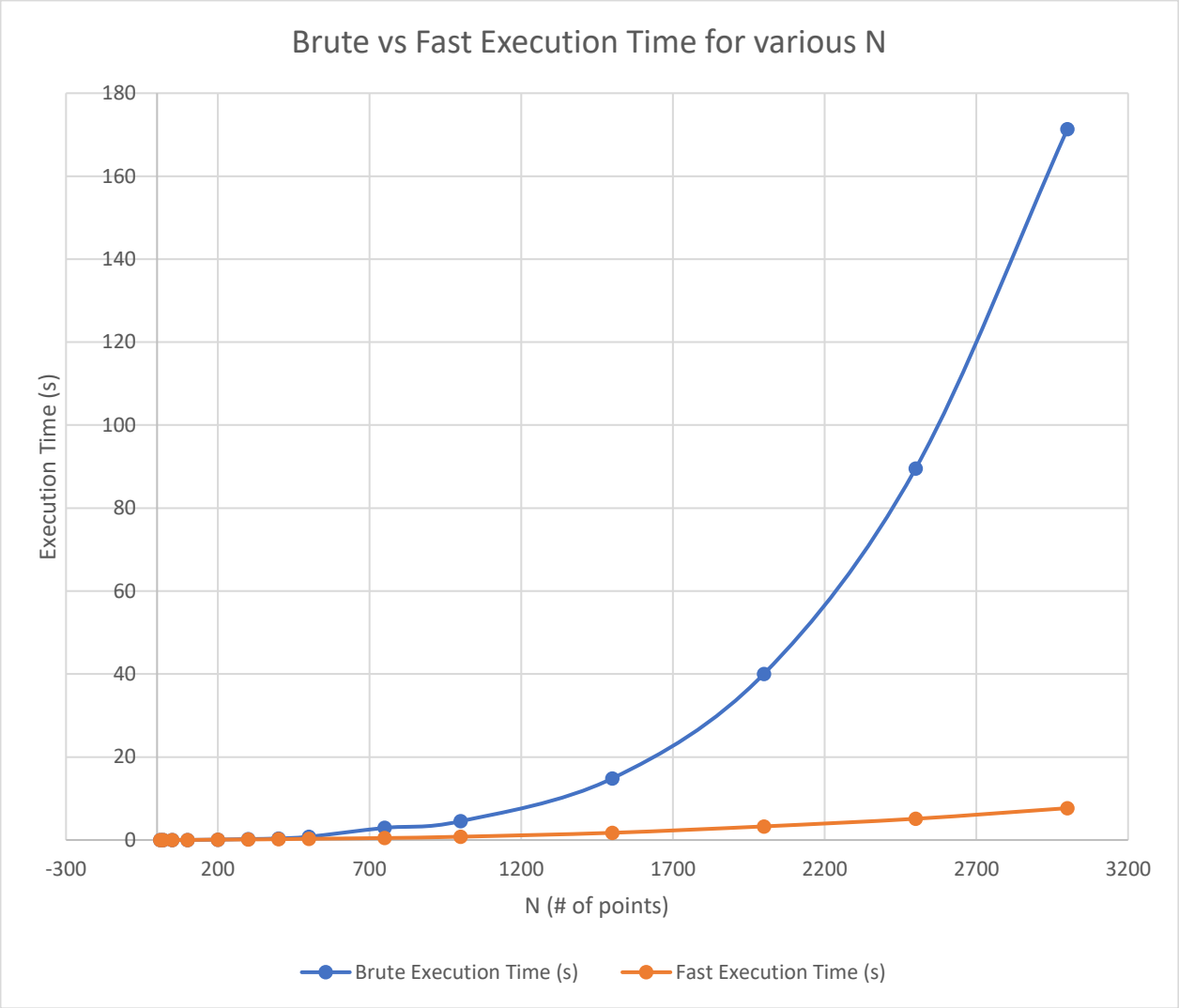
Real-World Execution Time Data

N (# of points)	10	20	50	100	200	300	400	500
Brute Execution Time (s)	0.003	0.003	0.003	0.01	0.091	0.222	0.364	0.786
Fast Execution Time (s)	0.002	0.003	0.004	0.012	0.09	0.125	0.193	0.291

N (# of points)	750	1000	1500	2000	2500	3000
Brute Execution Time (s)	2.923	4.521	14.826	40.044	89.546	171.344
Fast Execution Time (s)	0.473	0.786	1.731	3.277	5.118	7.672

Graph on next page…

Enlarged to show detail…



Estimation for N = 1,000,000

Brute – I believe the runtime would be around $1.004 * 10^{12}$ seconds, or a staggering 31, 837 years!

Fast – I believe the runtime would be around 899,800 seconds, or 10.41 days!

The difference between these algorithms is extremely clear, Fast is incredibly faster than Brute die to its very reduced time complexity within the code.