Vector vs Multiset Insertion Times

- *Hypothesis*: I believe the insertion time for the vector and multiset will be relatively the same for low values of N. However, the insertion time for the multiset will be noticeably lower for higher values of N.
- *Methods*: I followed these steps to get my results:
    1.) I instantiated a multiset and a vector. Then, I have a loop that inserts N random items into the multiset and vector. The vector insert uses std::upper_bound to do a binary search to find where the the random item should be placed within the sorted vector.
    2.) Using g++ as a compiler (with no flags), I timed the insertions for values of N at 100, 1000, 5000, 10000, 50000, 100000, and 500000 and placed those values in excel. For N <= 5000, I ran 100 iterations of each test and took the average of all the iterations to get more reliable data.
- *Results*:

N	Vector BS Insert Time (seconds)	Multiset Insert Time (seconds)
100	0.00006795	0.00006709
1000	0.00077037	0.00078447
5000	0.00513496	0.00446655
10000	0.0111854	0.0097474
50000	0.1260827	0.0572989
100000	0.416687	0.150503
500000	8.803873	1.269207

Vector BS Insert Time (seconds) and Multiset Insert Time (seconds)
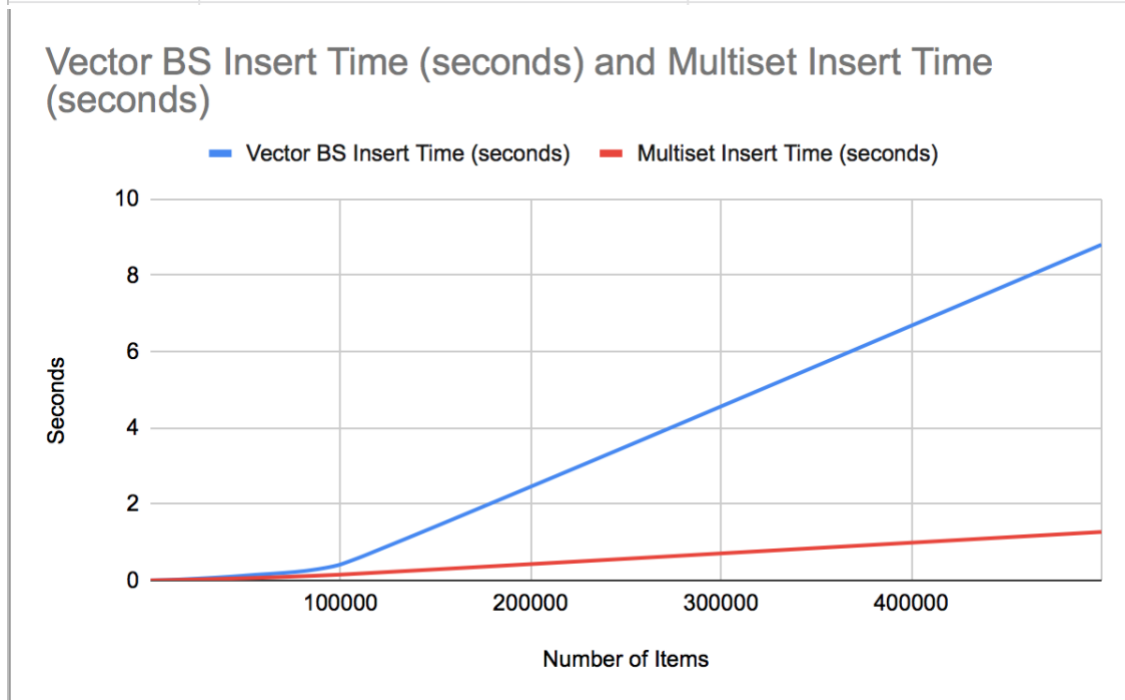
Explanation: The table above shows the average timing of the insertions. Below the table you can see a graph of insertion times vs *N*, with the blue curve being for insertion into a vector using binary search, and the red curve being insertions into a multiset.

- *Discussion*: What I found was that up until about N = 4000, the time it took to insert into a sorted vector and the time it took to insert into a multiset was about equal, but when N > 4000, the time it took to insert into a sorted vector drastically increased while the time it took to insert into a multiset increased at a slower rate. It was surprising to see that a sorted vector was able to insert as quickly as a multiset up until a very large value of N.
- *Conclusions*: For lower values of N, up until around N = 4000, the amount of time to insert into a sorted vector and a multiset was indistinguishable. However, when N > 4000, the multiset was noticeably faster to insert into. For very large values of N, such as 500000, the sorted vector took numerous seconds longer than the multiset.