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CS 2223: Algorithms

Homework 1 Question 2 Data:

The Linear Search Algorithm goes through a collection of inputs one by one, and stops once it finds the desired element.

The Binary Search Algorithm takes in an ordered set of inputs and parses through it by looking at a given element and seeing if it is more than, equal to, or less than the desired element and either searches the right side of the collection, returns that element, or searches the left side of the collection respectively.

The Binary Search Recursive Algorithm does the same thing as the Binary Search Algorithm, but in its implementation uses recursion to search the sub-collections.

Steps by Search Type and Size of Data (10 Simulations Each):

	100 datapoints	1000 datapoints	10000 datapoints	100000 datapoints	250000 datapoints
Binary Search Recursive	8, 8, 7, 8, 7, 8, 7, 8, 8, 8	7, 11, 9, 11, 9, 8, 11, 11, 10, 10	11, 7, 10, 9, 11, 8, 10, 10, 10, 9	10, 7, 9, 9, 6, 10, 7, 10, 9, 8	10, 9, 9, 9, 9, 10, 9, 10, 9, 10
Binary Search	7, 7, 7, 7, 6, 6, 7, 7, 6, 7	10, 4, 10, 10, 8, 10, 9, 9, 8, 10	6, 10, 10, 8, 10, 10, 8, 9, 10, 9, 11	9, 4, 6, 10, 8, 6, 7, 11, 11, 7	8, 10, 10, 10, 10, 9, 9, 8, 10, 10
Linear Search	100, 100, 100, 100, 100, 100, 100, 100, 100, 100	618, 1000, 1000, 758, 404, 76, 1000, 618, 1000, 683	5592, 7597, 6720, 9790, 9244, 6587, 802, 5505, 8389, 4824	9156, 46297, 49255, 96275, 38258, 72024, 43198, 25800, 17536, 7520	159355, 139540, 70265, 118821, 76060, 195957, 196277, 37011, 110418, 133001

Average Steps for Each Search Method and Input Size:

	100 datapoints	1000 datapoints	10000 datapoints	100000 datapoints	250000 datapoints
Binary Search Recursive	7.7	9.7	9.5	8.5	9.4
Binary Search	6.7	8.8	10.1	7.9	9.4
Linear Search	100	715.7	6505	40531.9	123671

## Steps By Sorting Algorithms

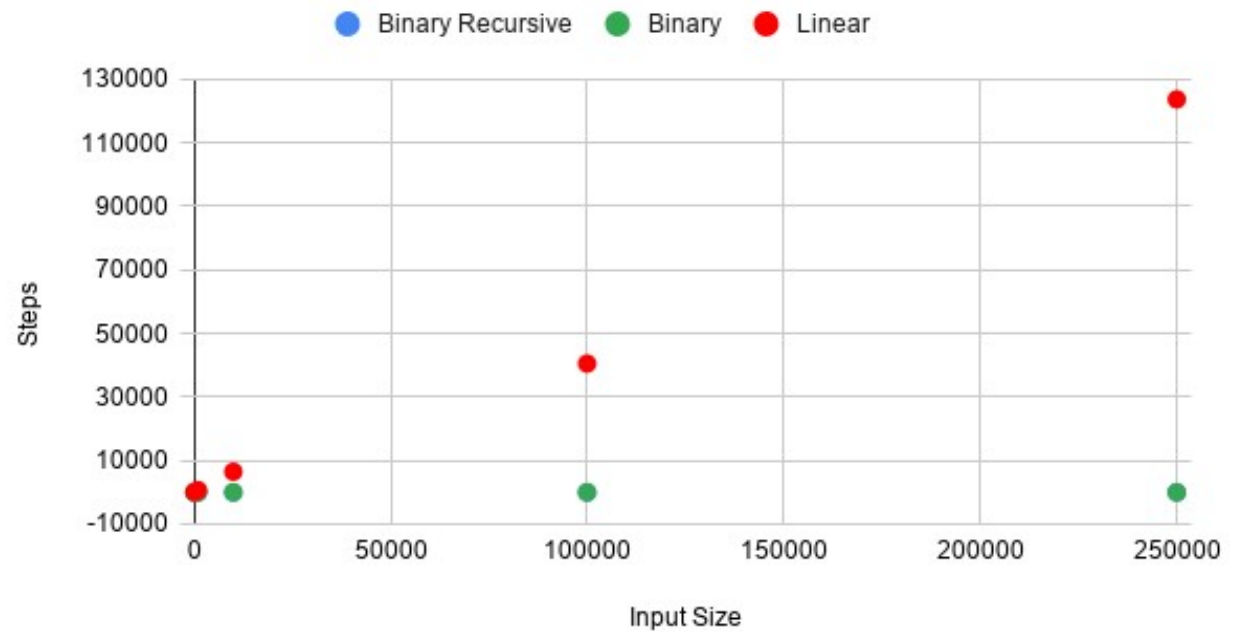


Figure 1. A graph showing all average data points, with blue points being Binary Search Recursive Simulations, green being Binary Search Simulations, and Red being Linear Search Simulations. X axis representing input size and Y axis representing total steps.

## Steps By Sorting Algorithms

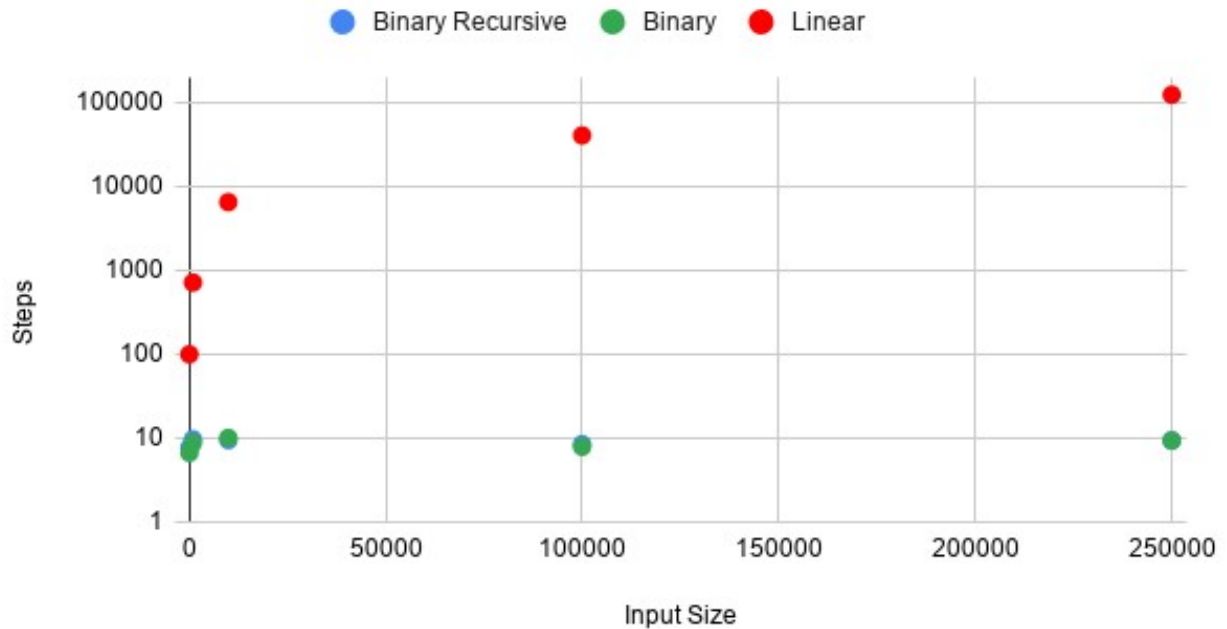


Figure 2. A graph showing the average datapoints, with a log scale applied to the vertical access for better comprehension.

As is clearly seen in Figure 1, the Linear Search algorithm is the least efficient by many orders of magnitude (reaching a peak number of steps of 195,957), while the Binary Search and Binary Search Recursive methods were both significantly more efficient (with a peak number of steps of 11 for both methods). Beyond this, the Binary Search and Binary Search Recursive algorithms were also much more precise and predictable than the Linear Search algorithm. The Linear Search algorithm (with an input size of 250,000) had a possible step range from 19,277 to 195,957 and has a theoretical step range of 1 to 250,000. The two Binary algorithms, however, both had step ranges from 8 to 10 for an input size of 250,000, and a theoretical range of 1 to around 18. Therefore, the Binary Search algorithms are superior to the Linear Search algorithm in both efficiency and predictability.