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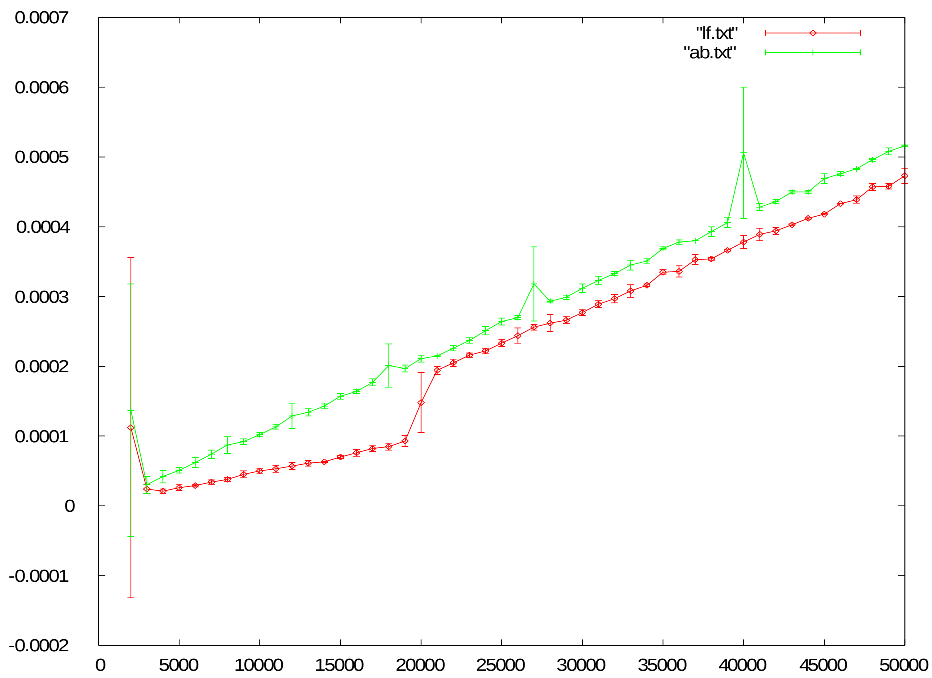
Assignment P2

It should be expected that adding elements to the beginning of a singly-linked list to take time independent of the size of the list. In order to add to the beginning of a singly-linked list, the new node must point to the node that the head dummy node points to, and the head dummy node must point to the new node. Since it takes time independent of the size of the list, the time cost should be O(n).

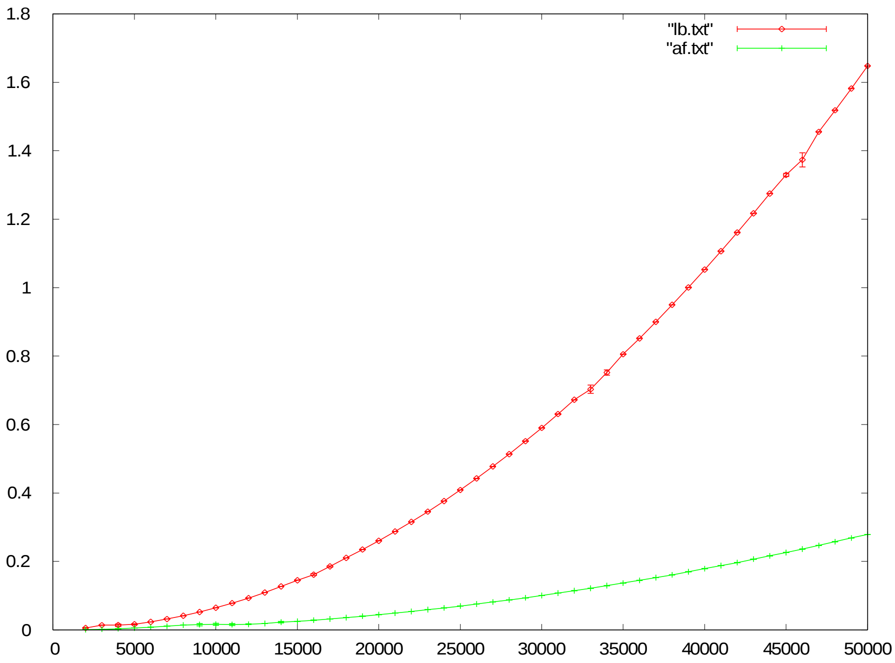
Adding to the end of an ArrayList should also have a time cost O(n) since the time it takes to add to the end of an ArrayList is independent of the size of the array.



As seen in the graph above, the data suggests that adding to the front of a linked list and adding to the back of an array list does have a time cost O(n). The red graph refers is a plot time it took to add N elements to the front of a linked list vs. the number of elements added. The red line seems appears to follow a linear plot, and the green line, referring to the time it took to add n elements to the back of an array list, is likewise following what seems to be a linear relationship. The data supports the expectation that they have a time cost O(n).

However, there seems to be some divergences in data along each plot. Given the time scale of this graph, it suggests that the times recorded were affected by “noise” caused by other processes in the background. Every possible precaution was taken to close any open windows to give the most consistent data possible. However, some noise is still expected, which can be seen in the divergences in both plots.

The time costs, however, of adding to the back of a singly-linked list and to the front of an ArrayList would be expected to be O(n^2). For the singly-linked list, since there's no direct pointer to the end of the list, the entire list must be traversed in order to get a reference to the end of the list. For an ArrayList, when adding to the front of the array, all the other elements must be shifted over. This leads to the expectation that their time costs must be O(n^2).



The above graph shows the measured time cost of adding N elements to the back of a singly-linked list (shown in red) and to the front of an array list (shown in green). The data from both graphs support that they have a time cost O(N^2) because they take the form of quadratic functions.

There seems to be less divergences in the data in the above graph than in the first graph, but the much larger time scale – tenths of a second in the above graph as opposed to ten-thousandths of a second in the first graph - of the above graph seems to influence the plot's apparent sensitivity to relatively large deviations in the time data. Since the time scale of the above graph is on the order of 10^-1 seconds, it is less influenced by the noise of background processes, which have a time scale closer to 10^-4, if not less.