A short report on Lab 1

The task for the first lab was to write a program to search for data in the list. For this, we use two searching algorithms: linear and binary search.

Procedure

At first, code for both linear and binary search was written. This was then tested using python unittest library. Tests ran successfully and the algorithm was validated. Then I move onwards to test the performance of both algorithms.
For linear search, 10000 to 300000 data points with an increment of 10000 each step were randomly generated in random order and simulated three cases: Best Case, Average Case and Worst-Case. For Best Case, we gave the algorithm to search for the first element in the list. For the average case, we randomly generated the data to be searched. For the worst case, we gave it the last data on the list.

For binary search, 10000 to 10000000 data points were used as this algorithm is significantly faster than previous algorithm and time measurements were done in nano seconds for the same reason. Since for binary search requires data to be sorted in ascending order, we generated numbers in ascending order. Similar to previous method, three tests were conducted. For Best Case, list's middle element was given as search value. For average case, we generated random value to be searched. For worst case, we generated data as complete binary tree and fed the last leaf node as search value.

Results
Linear Search (In Seconds):

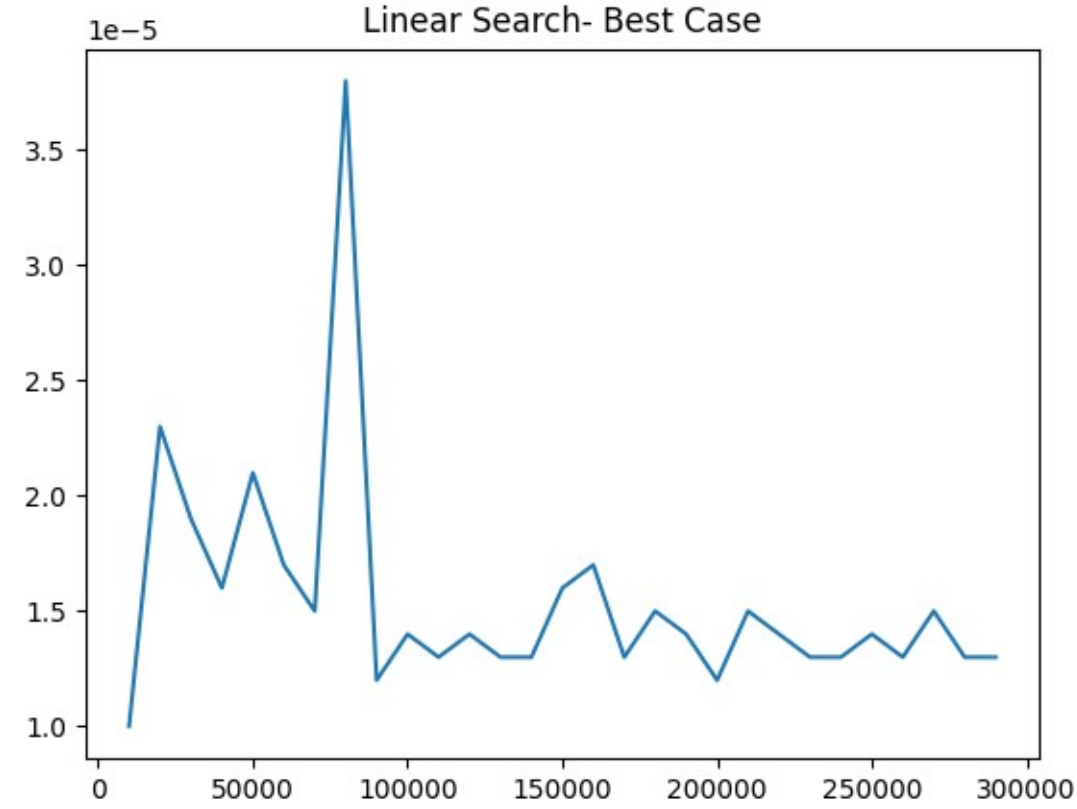
Worst Case
Elapsed Time for 10000 datas: 0.000798
Elapsed Time for 20000 datas: 0.001988
Elapsed Time for 30000 datas: 0.002228
Elapsed Time for 40000 datas: 0.003177
Elapsed Time for 50000 datas: 0.00331
Elapsed Time for 60000 datas: 0.003926
Elapsed Time for 70000 datas: 0.004514
Elapsed Time for 80000 datas: 0.007507
Elapsed Time for 90000 datas: 0.013666
Elapsed Time for 100000 datas: 0.013993
Elapsed Time for 110000 datas: 0.056185
Elapsed Time for 120000 datas: 0.017898
Elapsed Time for 130000 datas: 0.02367

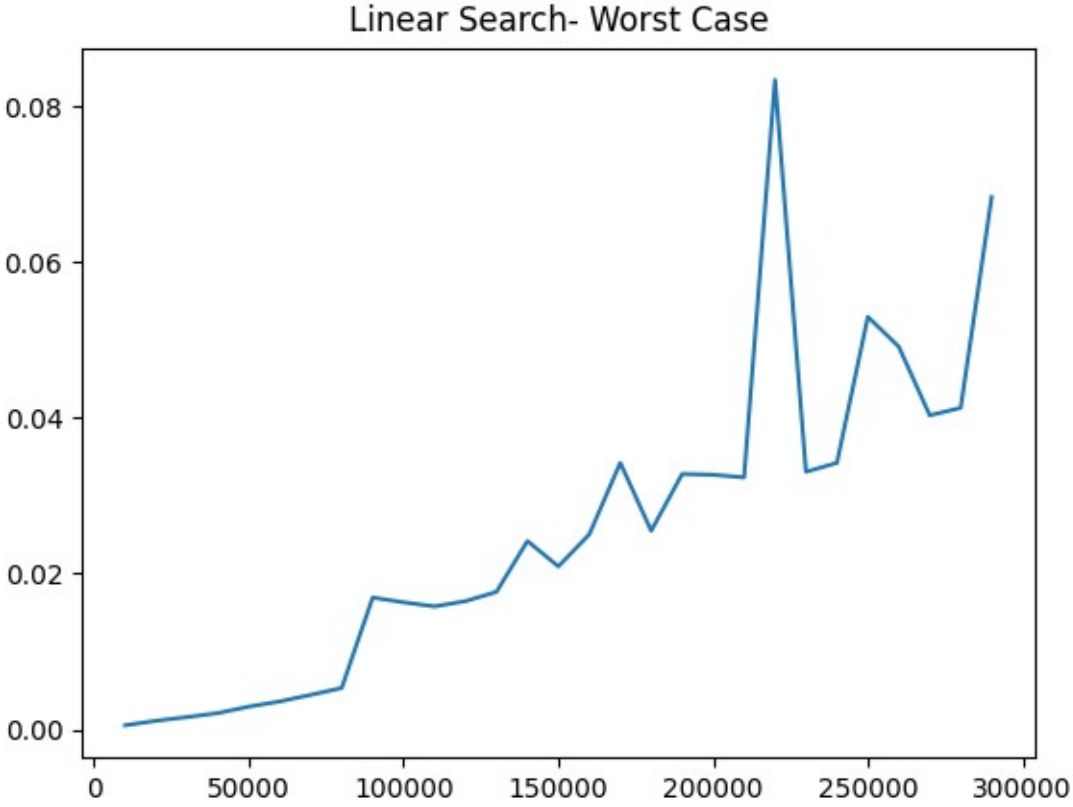
Elapsed Time for 140000 datas: 0.055672
Elapsed Time for 150000 datas: 0.028391
Elapsed Time for 160000 datas: 0.032385
Elapsed Time for 170000 datas: 0.036983
Elapsed Time for 180000 datas: 0.029536
Elapsed Time for 190000 datas: 0.026411
Elapsed Time for 200000 datas: 0.037
Elapsed Time for 210000 datas: 0.035892
Elapsed Time for 220000 datas: 0.0309
Elapsed Time for 230000 datas: 0.032893
Elapsed Time for 240000 datas: 0.059181
Elapsed Time for 250000 datas: 0.060668
Elapsed Time for 260000 datas: 0.066853
Elapsed Time for 270000 datas: 0.03909
Elapsed Time for 280000 datas: 0.040097
Elapsed Time for 290000 datas: 0.050133

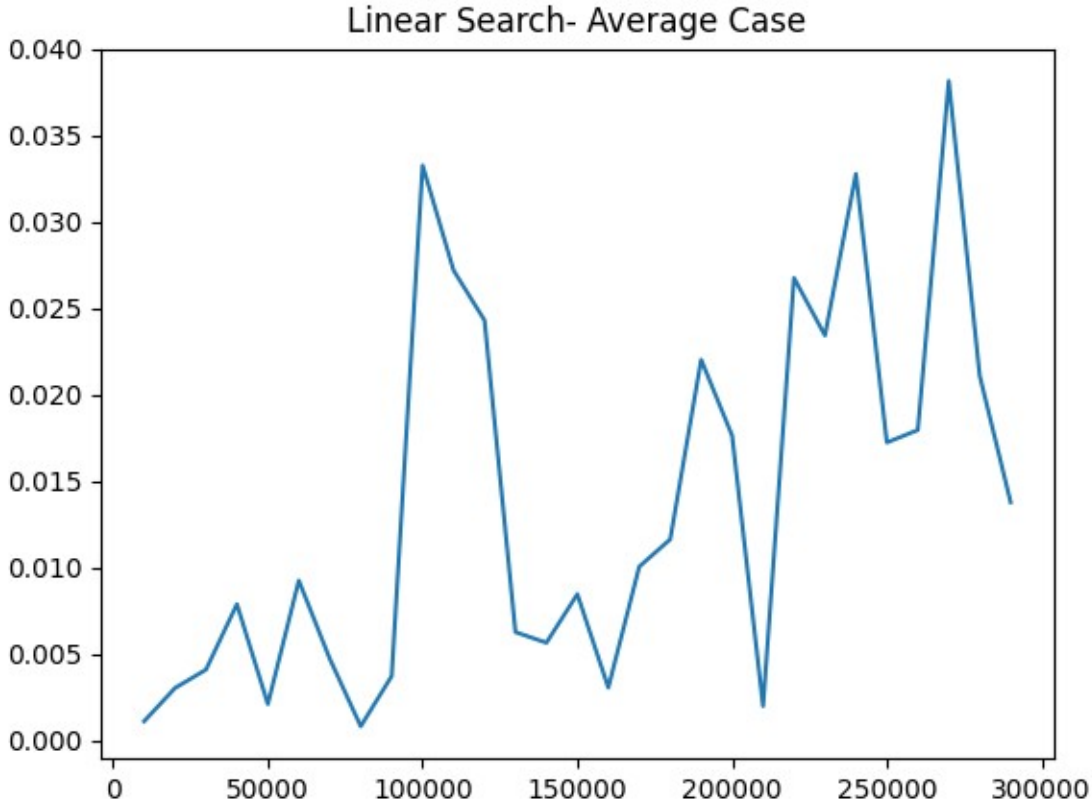
Best Case
Elapsed Time for 10000 datas: 1e-05
Elapsed Time for 20000 datas: 2.3e-05
Elapsed Time for 30000 datas: 1.9e-05
Elapsed Time for 40000 datas: 1.6e-05
Elapsed Time for 50000 datas: 2.1e-05
Elapsed Time for 60000 datas: 1.7e-05
Elapsed Time for 70000 datas: 1.5e-05
Elapsed Time for 80000 datas: 3.8e-05
Elapsed Time for 90000 datas: 1.2e-05
Elapsed Time for 100000 datas: 1.4e-05
Elapsed Time for 110000 datas: 1.3e-05
Elapsed Time for 120000 datas: 1.4e-05
Elapsed Time for 130000 datas: 1.3e-05
Elapsed Time for 140000 datas: 1.3e-05
Elapsed Time for 150000 datas: 1.6e-05
Elapsed Time for 160000 datas: 1.7e-05
Elapsed Time for 170000 datas: 1.3e-05
Elapsed Time for 180000 datas: 1.5e-05
Elapsed Time for 190000 datas: 1.4e-05
Elapsed Time for 200000 datas: 1.2e-05
Elapsed Time for 210000 datas: 1.5e-05
Elapsed Time for 220000 datas: 1.4e-05
Elapsed Time for 230000 datas: 1.3e-05
Elapsed Time for 240000 datas: 1.3e-05

Elapsed Time for 250000 datas: 1.4e-05
Elapsed Time for 260000 datas: 1.3e-05
Elapsed Time for 270000 datas: 1.5e-05
Elapsed Time for 280000 datas: 1.3e-05
Elapsed Time for 290000 datas: 1.3e-05

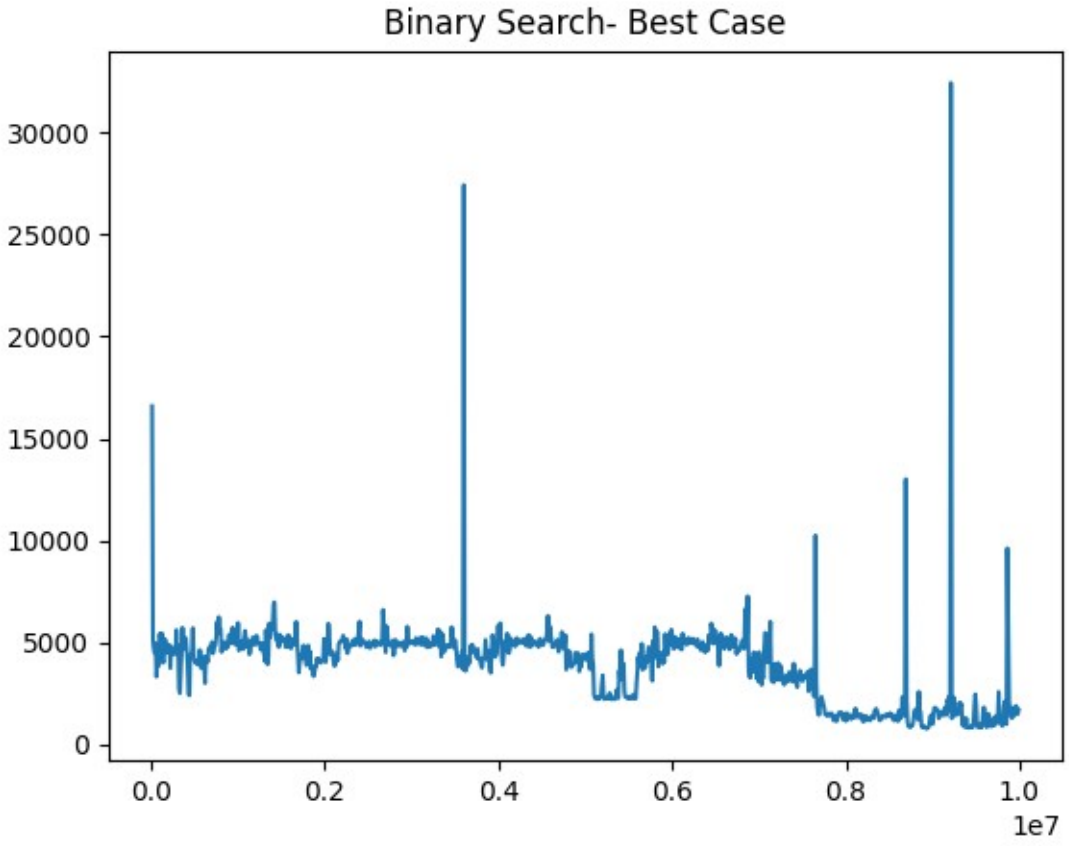
Average Case
Elapsed Time for 10000 datas: 0.001105
Elapsed Time for 20000 datas: 0.003032
Elapsed Time for 30000 datas: 0.004094
Elapsed Time for 40000 datas: 0.007881
Elapsed Time for 50000 datas: 0.002101
Elapsed Time for 60000 datas: 0.009247
Elapsed Time for 70000 datas: 0.004724
Elapsed Time for 80000 datas: 0.000818
Elapsed Time for 90000 datas: 0.003721
Elapsed Time for 100000 datas: 0.033262
Elapsed Time for 110000 datas: 0.027192
Elapsed Time for 120000 datas: 0.024303
Elapsed Time for 130000 datas: 0.006267
Elapsed Time for 140000 datas: 0.005651
Elapsed Time for 150000 datas: 0.00846
Elapsed Time for 160000 datas: 0.003054
Elapsed Time for 170000 datas: 0.010056
Elapsed Time for 180000 datas: 0.011632
Elapsed Time for 190000 datas: 0.022023
Elapsed Time for 200000 datas: 0.017633
Elapsed Time for 210000 datas: 0.001985
Elapsed Time for 220000 datas: 0.026751
Elapsed Time for 230000 datas: 0.023426
Elapsed Time for 240000 datas: 0.03277
Elapsed Time for 250000 datas: 0.017235
Elapsed Time for 260000 datas: 0.017954
Elapsed Time for 270000 datas: 0.038151
Elapsed Time for 280000 datas: 0.021099
Elapsed Time for 290000 datas: 0.013775

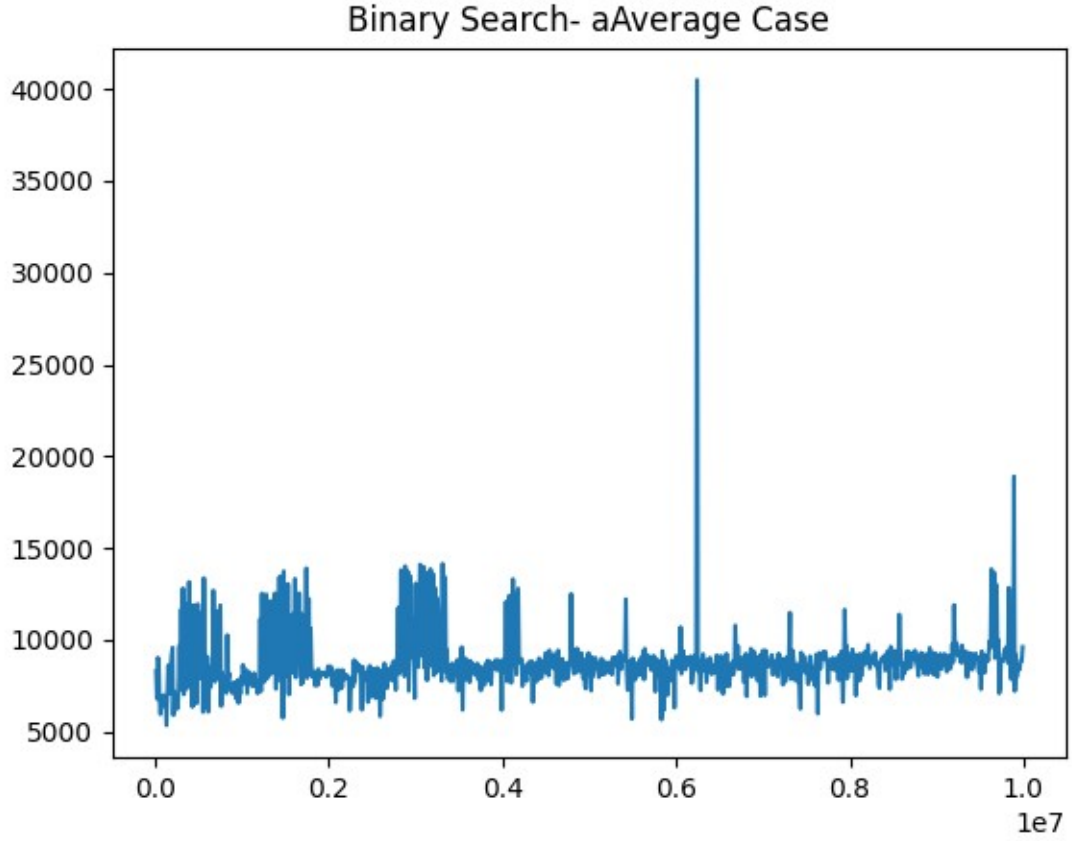

Linear Search- Best Case
1e−5
3.5
3.0
2.5
2.0
1.5
1.0
0
50000
100000
150000
200000
250000
300000

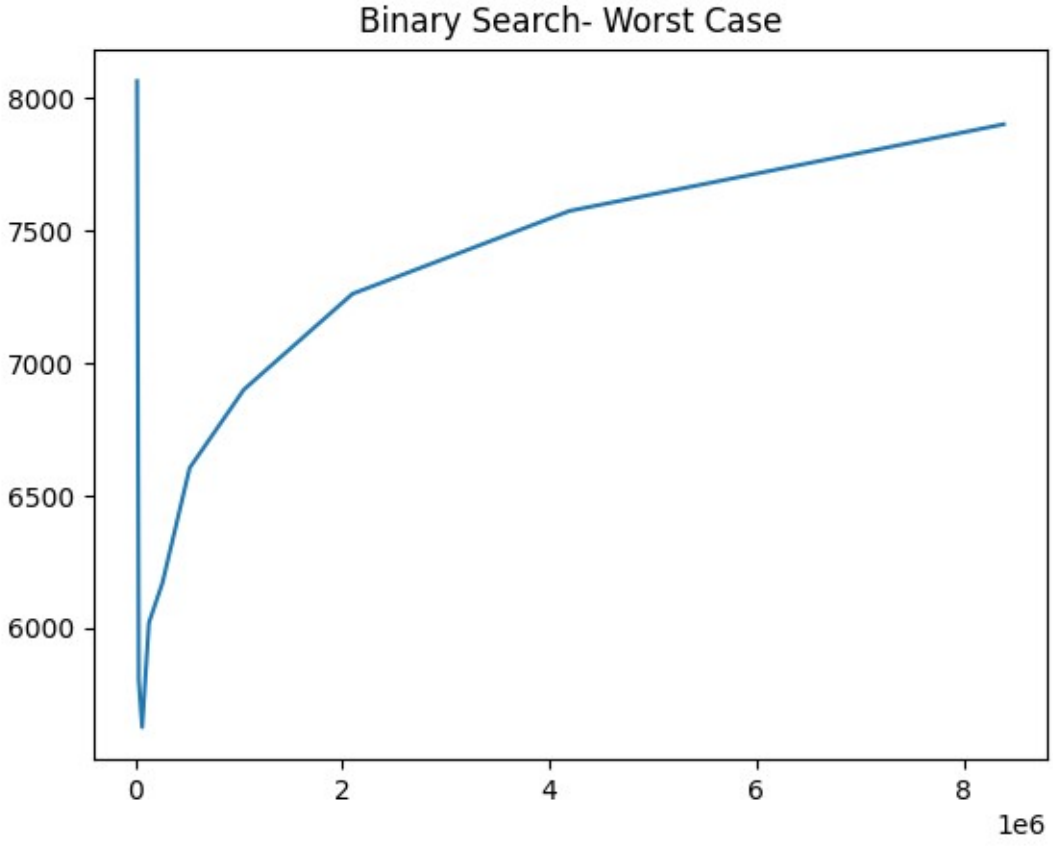

Linear Search- Worst Case
0.08
0.06
0.04
0.02
0.00
0
50000
100000
150000
200000
250000
300000


Linear Search- Average Case
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
50000
100000
150000
200000
250000
300000

Binary Search (In ns):
As there are too many time points, we'll only show plots of the result.




Binary Search- aAverage Case
40000
35000
30000
25000
20000
15000
10000
5000
0.0
0.2
0.4
0.6
0.8
1.0
1e7


Binary Search- Worst Case
8000
7500
7000
6500
6000
0
2
4
6
8
1e6

Conclusion

From the above time measurements as well as graphs we can see that, in linear search, for worst case the results grows linearly as number of points increases. So the time complexity can be interpreted as O(n). For binary search, it can be seen that time increases logarithmitically. So the time complexity is O(log(n)).