Exercise 1

Do the empirical analysis of resizing-array based stack and linked-list based stack.

(a) Using the code provided in the lecture notes, implement the resizing-array based stack and linked-list based stack.

(b) Write a test program that performs 1 million push operations. Calculate the worst-case and average time taken to perform a push operation.

Exercise 2

Write a program that empirically tests the time complexity of the binary search and linear search algorithm. Create an array of integers and remove the duplicate values before to run the search algorithms to search a key value in an array. Find time taken by these algorithms. To measure the system time use ctime library.

Due to the fact that our algorithms are dependent on system resources therefore the time taken by the same algorithm for the same value might be different on different time slot. Therefore, system time is not consistent. Thus, rather than using the system time, count the number of comparison operations based on each algorithm in the array of different sizes. Compare the algorithms based on their growth rate as data size increases.

N	BinarySearch Comparison Statements	LinearSearch Comparison Statements
10	3	10
100	7	100
1000	–	–
5000	–	–

Table 1: Runtime analysis data recorded using code.

To verify your counts for the binary search, calculate $\log_2(N)$. Fill the data in the above Table and draw graph in excel for the Table.

Exercise 3

Verify the running time of $N^2 \log(N)$ algorithm for 3-Sum algorithm (as studied in the lecture) empirically.

Exercise 4

Write a function, void myfunc(int[] A, int N), whose formula for the running time should be similar to $T(N) = N^3 + N + N\log(N)$. The formula for your algorithm may differ slightly but it should have all the three complexity factors. Feel free to use loops, nested loops, conditional statements, function calls, etc. Also, compute the count of primitive operations for

1. $T(N)$
2. and for the dominant term (which defines the order-of-growth) in $T(N)$

for the values of N from 10 to 1000. Plot the counts for i) and ii) on a chart in MS Excel. At what value of N, the dominant term accounts for more than 99.5% of the counts? Submit the code and the MS Excel files.