CSE 5311-005 DESIGN & ANALYSIS OF ALGORITHMS Hands On 3

1.
$$T(n) = c_1(1) + c_2 \sum_{i=1}^{n+1} (1) + c_3 \sum_{i=1}^n \sum_{j=1}^{n+1} 1 + c_4 \sum_{i=1}^n \sum_{j=1}^n (1)$$

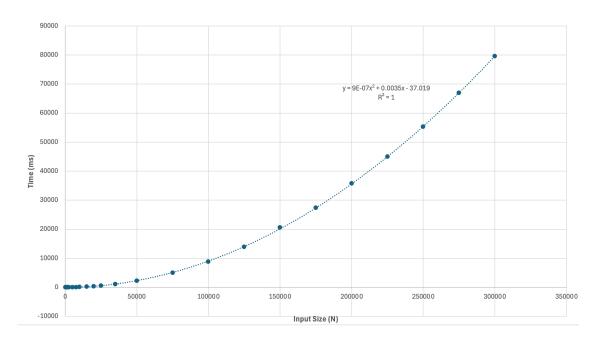
$$= c_1 + c_2(n+1) + c_3(n)(n+1) + c_4(n^2)$$

$$= c_1 + c_2(n+1) + c_3(n^2 + n) + c_4(n^2)$$

$$= (c_3 + c_4)n^2 + (c_2 + c_3)n + (c_1 + c_2)$$

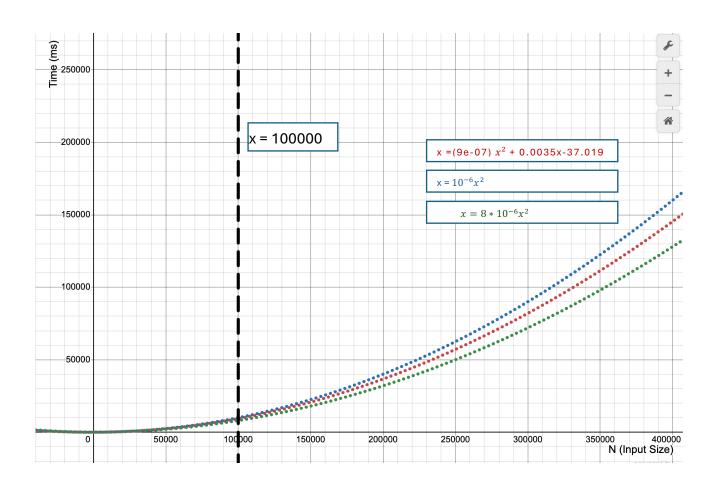
$$= \Theta(n^2)$$

500 1 1000 4 1250 6 1500 7 2000 9 2500 17 5000 37 7500 68 10000 92 15000 196 20000 346 25000 549 35000 1065 50000 2210 75000 4975 100000 8848 125000 13917 150000 20581 175000 27379 200000 35794 225000 55306	Input Size (N) ▼	Runtime (ms) ▼
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125000 13917 150000 20581 175000 27379 200000 35794 225000 44974 250000 55306 275000 66963	75000	4975
150000 20581 175000 27379 200000 35794 225000 44974 250000 55306 275000 66963	100000	8848
175000 27379 200000 35794 225000 44974 250000 55306 275000 66963	125000	13917
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225000 44974 250000 55306 275000 66963	175000	27379
250000 55306 275000 66963	200000	35794
275000 66963	225000	44974
	250000	55306
300000 79645	275000	66963
	300000	79645



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3.



From the above graph, a good upper bound for $f(x) = (9 * 10^{-7}) x^2 + 0.0035x - 37.019$ would be $f(x) = 10^{-6}x^2$ and a good lower bound would be $f(x) = (8 * 10^{-6})x^2$.

From this we can say, $O(f(x)) = x^2$, $\Omega(f(x)) = x^2$, and $\Theta(f(x)) = x^2$

4.

From the above graph, a good value for n_0 would be $n_0 = 100000$ since the curve f(x) is sandwiched between the upper and lower bounds for all values of $x \ge n_0$

- 4. Will this increate how long it takes the algorithm to run (e.x. you are timing the function like in #2)? The addition of the lines y = 1, and y = i + j; will increase the time slightly. Escpecially the second line, y = i + j is inside of a loop, so it has to be executed n more times. However, the time will not increase drastically since the asymptotic complexities will remain the same.
- 5. The addition of the lines y = 1, and y = i + j will add a constant term and a linear term respectively to the runtime function T(n) found in 1. However, since the dominant term n^2 is unchanged, the asymptotic complexity will remain the same.