# Assignment1

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This homework was written in LaTeX

## 1 Question 1

a. Recall that the formal definition of big-O says that $f(n) = O(g(n))$ if there exist constants c, $n_0 > 0$ such that $f(n) \leq c \cdot g(n)$ for all $n \geq n_0$. Using this definition, show that $100n + 200 = O(n)$.

In this case, g(n) = n. So we need a constant c and n0 such that $100n+200 \leq c \cdot n$, for all $n \geq n + 0$. Let's say $c = 200$ and $n_0 = 2$, so

$$\begin{aligned} 100n + 200 &\leq 200n \\ 200 &\leq 100n \\ n_0 = 2 &\leq n \end{aligned} \tag{1}$$

b. Fill in rows a-e in CLRS Problem 3.2, "Asymptotic Growth Rates." You may copy and fill in the table, or reproduce it.

See Figure 1 below

## 2 Question 2

a. See the attached python file.
b. See the attached python file.
c. See Figure 2 below
d. Two different algorithm has totally different runtime because the different complexity, one is $O(n^2)$ and another is $O(n^3)$. When our test data is relatively small, the role of leading constants will be more obvious. When thousands of data are involved and we have to perform millions of the "for" loop, leading constants are no longer important.

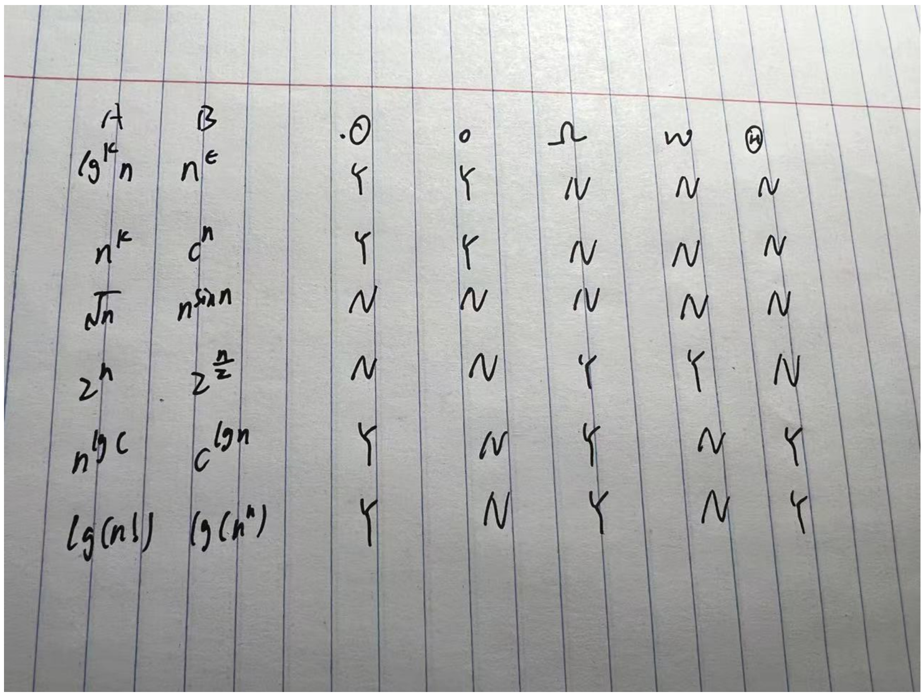


Figure 1: Solution to 1b.

| | 500 | 1000 | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 | 4500 | 5000 |
|---|---|---|---|---|---|---|---|---|---|---|
| enumeration | 463 | 4013 | 13492 | 32173 | 62969 | 108992 | 174671 | 263390 | 375915 | 512441 |
| iteration | 3 | 14 | 31 | 57 | 90 | 129 | 176 | 234 | 290 | 351 |

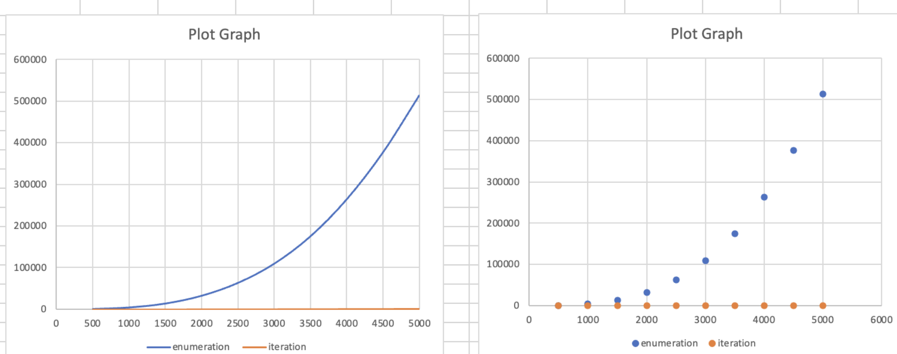


Figure 2: Solution to 2c.