

CMSC 341 Data Structure

Asymptotic Analysis Review

These questions will help test your understanding of the asymptotic analysis material discussed in class and in the text. These questions are only a study guide. Questions found here may be on your exam, although perhaps in a different format. Questions NOT found here may also be on your exam.

1. What is the purpose of asymptotic analysis?
2. Define “Big-Oh” using a formal, mathematical definition.
3. Let $T_1(x) = O(f(x))$ and $T_2(x) = O(g(x))$. Prove $T_1(x) + T_2(x) = O(\max(f(x), g(x)))$.
4. Let $T(x) = O(cf(x))$, where c is some positive constant. Prove $T(x) = O(f(x))$.
5. Let $T_1(x) = O(f(x))$ and $T_2(x) = O(g(x))$. Prove $T_1(x) * T_2(x) = O(f(x) * g(x))$
6. Prove $2^{n+1} = O(2^n)$.
7. Prove that if $T(n)$ is a polynomial of degree x , then $T(n) = O(n^x)$.
8. Number these functions in ascending (slowest growing to fastest growing) Big-Oh order:

Number	Big-Oh
	$O(n^3)$
	$O(n^2 \lg n)$
	$O(1)$
	$O(\lg^{0.1} n)$
	$O(n^{1.01})$
	$O(n^{2.01})$
	$O(2^n)$
	$O(\lg n)$
	$O(n)$
	$O(n \lg n)$
	$O(n \lg^5 n)$

9. Determine, for the typical algorithms that you use to perform calculations by hand, the running time to:

- a. Add two N-digit numbers
- b. Multiply two N-digit numbers

10. What is the asymptotic performance of each of the following?

Select among:

- a. $O(n)$
- b. $O(n^2)$
- c. $O(n \lg n)$
- d. $O(n^3)$
- e. $O(\lg n)$
- f. $O(1)$
- g. $O(n!)$
- h. None of these

- (a) _____ Squaring each element of an NxN matrix
- (b) _____ Finding the smallest value in a sorted array of N integers
- (c) _____ Finding a value in a sorted array using binary search
- (d) _____ Pushing N elements onto a stack, then popping them and printing them
- (e) _____ Finding the largest 3 values in an unsorted array

11. What is the asymptotic performance of the following Java code fragment?

Justify your answer.

```
for (int i = 0; i < N; i++)
{
    for (int j = 10; j >= 0; j--)
    {
        int count = 1;
        while (count < N)
            count *= 2;
    }
}
```