

CMSC 341 Data Structure Asymptotic Analysis Review

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 $T(x) = O(cf(x))$. 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 C++ 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;
    }
}

```