

CS240 Fundamentals

Complete the following problems without a calculator. You will need to know all these concepts for this class!

1. Functions

Given this function: $T(n) = 5 + n^2$

(a) What are the values of: $T(0) = \underline{5}$ $T(1) = \underline{6}$ $T(2) = \underline{9}$

(b) Consider an arbitrary value, c . What is: $T(c) = \underline{5 + c^2}$ $T(c+1) = \underline{5 + (c+1)^2 = c^2 + 2c + 6}$

2. Algebra

(a) Simplify the following: $\frac{n^2 + 3n}{n^2} = \underline{1 + \frac{3}{n}}$ $\frac{T(n)}{n} = \underline{\frac{5}{n} + n}$ (from problem 1)

(b) Solve the following inequalities (find the range of values of x that satisfies the inequality):

$x + 5 < 8$ This is true when: $\underline{x < 3}$

$x^2 - 4 \geq 0$ This is true when: $\underline{x \leq -2, x \geq 2}$

3. Powers of 2

(a) Write the powers of 2 starting from 2^0 to 2^{10} . The first three have been completed for you.

2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8	2^9	2^{10}
1	2	4	8	16	32	64	128	256	512	1024

(b) Solve the following: $\log_2 8 = \underline{3}$ $\log_2 512 = \underline{9}$ $\log_2 2^{100} = \underline{100}$

(c) Now solve these: $2^{\log_2 1701} = \underline{1701}$ $2^{\log_2 x} = \underline{x}$

4. Graphs

Fill in the blanks to match each function to the line that best represents its growth (graph is not shown exactly to scale):

Possible functions:

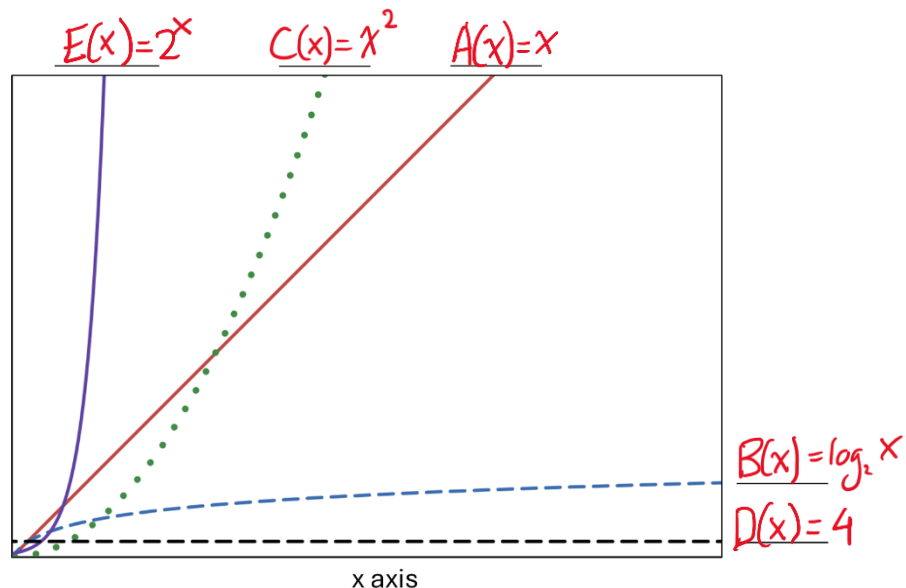
$A(x) = x$

$B(x) = \log_2 x$

$C(x) = x^2$

$D(x) = 4$

$E(x) = 2^x$



5. Code Tracing and Counting

Consider the following code, which prints out a number of A's.

```
public static void printAs(int n) {  
    for (int i = 0; i < n; i++) {  
        System.out.print("A");  
        System.out.print("A");  
    }  
}
```

(a) Trace through the code for `printAs(5)`. How many A's get printed? 10

(b) Let's say that $A(n)$ is a function that represents the number of A's that gets printed for a given input, n .

Trace through the code for the following inputs and determine:

$A(1) =$ 2 $\quad A(2) =$ 4 $\quad A(3) =$ 6 $\quad A(4) =$ 8

(c) Generalize. Write a function $A(n)$ with respect to any value of n that properly represents the number of A's that gets printed when calling `printAs`:

$A(n) =$ $2n$

6. More Counting

Consider the following code, which prints out a number of B's.

```
public static void printBs(int n) {  
    for (int i = 0; i < n; i++) {  
        for (int j = 0; j < n; j++) {  
            System.out.print("B");  
        }  
    }  
}
```

(a) Trace through the code for `printBs(2)`. How many B's get printed? 4

(b) Write a function that represents the number of B's printed for a given input:

$B(n) =$ n^2

7. Even More Counting (yes this is a fundamental part of the class)

Consider the following code, which prints out a number of C's.

```
public static void printCs(int n) {  
    System.out.print("C");  
  
    for (int i = 0; i < n; i++) {  
        System.out.print("C");  
    }  
}
```

Write a function that represents the number of C's printed for a given input:

$C(n) =$ $1 + n$