

# Honors Homework 5: Recurrences

CMSC 250H

Due Date: Feb 22, 9:00AM, HARD DEADLINE

For Programming Problems: Send your code to Emily by email. Send the actual .java/.py/ect file. You need to use your .umd email address or it will not send. In your pdf, you must have the output your code provides. You can screenshot this or type it in. Hint: Use Python.

Consider the following recurrences:

(In all cases assume the first few values that are not well defined all 1. For example

$n = 0$ :  $a_0 = a_0 + 0$ , this does not work, so we set  $a_0 = 1$ .

$n = 1$ :  $a_1 = a_1 + 1$ , this does not work so we set  $a_1 = 1$ .

$n = 2$ :  $a_2 = a_1 + 1 = 1 + 1 = 2$ , this is fine, so use the recurrence.

$n = 0$ :  $d_0 \lg(0)$  does not exist! so set  $d_0 = 1$ .

$n = 1$ :  $d_1 = d_0 + \lg(1) = 1 + 0 = 1$ . This does work.

)

1.  $a_n = a_{\lfloor \sqrt{n} \rfloor} + \lfloor \sqrt{n} \rfloor$ .

2.  $b_n = b_{\lfloor \sqrt{n} \rfloor} + \lfloor \lg n \rfloor$ .

3.  $c_n = c_{\lfloor \lg n \rfloor} + \lfloor \sqrt{n} \rfloor$ .

4.  $d_n = d_{\lfloor \lg n \rfloor} + \lfloor \lg n \rfloor$ .

Do the following

1. For each recurrence write a program that, by dynamic programming, on input  $n$ , computes it for  $n = 0, \dots, 100$ .
2. (1 point) Plot all four on the same graph.
3. (4 points) For each one how does the behavior look? (linear? sqrt? log?)
4. (1 point) Just from looking at the equations one would guess (and be right) that  $a_n$  grows the fastest and  $d_n$  grows the slowest. but  $b_n$  vs  $c_n$  is not obvious. How do they compare?