

EC330 Applied Algorithms and Data Structures for Engineers Spring 2021

Homework 2

Out: February 17, 2021

Due: February 25, 2021

This homework has a written part and a programming part. Both are due at 11:59 pm on February 25. You should submit both parts on Gradescope.

This is an individual assignment. See course syllabus for policy on collaboration.

1. Asymptotic Comparison [50 pt]

In each of the following situations, indicate whether $f = O(g)$, or $f = \Omega(g)$, or both (i.e. $f = \Theta(g)$). Justify your choice. [5 pt each]

	$f(n)$	$g(n)$
a)	$n^{1/4}$	$n^{2/3}$
b)	$330n + \log n$	$n + (\log n)^2$
c)	$330 \log n$	$\log(n^2)$
d)	$n^{1.01}$	$n \log^2 n$
e)	$n^2 / \log n$	$n (\log n)^2$
f)	$(\log n)^{\log n}$	$n / \log n$
g)	\sqrt{n}	$(\log n)^3$
h)	$n^{1/2}$	$5^{\log_2 n}$
i)	$n2^n$	3^n
j)	$(\log n)^{\log n}$	$2^{(\log_2 n)^2}$

2. Programming [50 pt]

- a) Consider the infinite sequence 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, Write a program that outputs the k^{th} ($k > 0$) digit in this sequence. For example, the 1st digit is 0, the 3rd digit is 2, and the 12th digit is 0. The function declaration is given below.

int kthDigit(int k);

Your job is to implement the *kthDigit* function in *kthDigit.cpp*. Submit your solution on Gradescope. [20 pt]

- b) Write a program that accepts an integer array *nums* and returns the sum *closest* to 330 by adding up *three* integers in this array. For example, if *nums* = [20, 120, 200, 5], then the function should return 325 because $325 = 200 + 120 + 5$

is closer to 330 than $340 = 200 + 120 + 20$. If there is a *tie*, output the *smaller* sum. The function declaration is given below.

```
int sumTo330(vector<int> nums);
```

Your job is to implement the *sumTo330* function in *sumTo330.cpp*. Submit your solution on Gradescope. You will receive 10 bonus points if your solution runs in time $\mathbf{O(n^2)}$. **[30 pt + 10 pt bonus]**