

## Midterm 1 Take Home Questions

CSE 2321

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*You can work with classmates on these (in fact, I encourage it), but nobody else.*

Work this problem out and create a **pdf** file. If you're not working electronically already, there are apps for both iOS and Android that will turn a smartphone photo into a pdf file including the built-in note-taking apps. Whatever method you use, please make sure that it is legible and that your name is at the top of the first page of your work. You will be uploading it to Carmen/Canvas on the day of the midterm (Friday, February 9).

- 1.) (20 points) Prove, using induction, that

$$\sum_{k=1}^N \frac{1}{2k(2k+2)} = \frac{N}{4N+4}$$

is true for all natural numbers  $N \geq 1$ .

- 2.) (10 points) We can expand the  $O$ ,  $\Omega$ ,  $\Theta$  notation to the case of two<sup>1</sup> parameters,  $n$  and  $m$ , that can grow independently at different rates. For example if  $g : \mathbb{N}^2 \rightarrow \mathbb{R}^+$  then

$$O(g(n, m)) = \{f(n, m) \mid (\exists c, n_0, m_0 > 0)(\forall n \geq n_0, m \geq m_0)[f(n, m) \leq cg(n, m)]\}.$$

Give similar definitions for  $\Omega(g(n, m))$  and  $\Theta(g(n, m))$ . (Note: The easy answer for  $\Theta$  is fine.)

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<sup>1</sup>Or more. For example, the standard method of multiplying an  $m \times n$  matrix by an  $n \times \ell$  matrix is in  $\Theta(n \cdot m \cdot \ell)$ .