CSE 151A Winter 2021 - Take Home Exam 0

1 hour **Name:** **PID:**

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(1) This is an open book, open notes exam. You are free to consult any text book or notes. **You are not allowed to consult with any other person.**

(2) If you need any clarification, please post a private message to the instructors on Piazza.

(3) Remember that your work is graded on the *clarity* of your writing and explanation as well as the validity of what you write.

(4) This is a one-hour exam.

(1) Let X and Y be random variables with the following joint distribution.

	$X=1$	$X=2$	$X=3$
$Y=0$	1/4	1/4	1/4
$Y=1$	1/12	0	1/6

Now answer the following questions.

(a) (4 points) What are the marginal distributions of X and Y?

(b) (4 points) What are the conditional expectations $\mathbb{E}[X|Y=1]$ and $\mathbb{E}[Y|X=1]$?

(c) (2 points) Are X and Y independent? Justify your answer.

(2) (5 points) Let $a_1, \ldots, a_k$ be k real numbers. Consider the following function:

$$f(x) = \sum_{i=1}^{k} \log(1 + e^{a_i x})$$

Write down the derivative of $f(x)$. Use this derivative to write down a condition on the numbers $a_1, \ldots, a_k$ that ensures that $f(x)$ is strictly increasing at $x = 0$.

(3) (5 points) Let $v_1 = [3, 5, 1]$, $v_2 = [2, 1, 3]$ and $v_3 = [12, 13, 11]$. Are v_1, v_2 and v_3 linearly independent? Justify your answer.