PRELIM EXAM

CSCI 8265: Trustworthy Machine Learning
Fall 2023

Thursday, August 17, 2023

Student name:

UGAID:

There are 4 problems of 100 points in total.
The last page is Page 4.

1. Calculus (20 pts)

   (a) (10 pts) If $y = \ln(b \cdot x)$, then compute $\frac{\partial y}{\partial x}$.

   (b) (10 pts) If $y = \exp(a \cdot x)$, then compute $\frac{\partial y}{\partial x}$.

   Answer:

2. Linear Algebra (30 pts)

   (a) (5 pts) Given $\mathbf{w} = [0, 2, 1]$, $\mathbf{x} = [1, 1, 0]$, compute $\mathbf{w} \cdot \mathbf{x}^T$.

   (b) (5 pts) Given $\mathbf{X} = [0, 1, 1; 1, 0, 0]$, $\mathbf{w} = [0, 1, 2]$, compute $\mathbf{X} \cdot \mathbf{w}^T$.

   (c) (10 pts) If $f = \mathbf{w}^T \cdot \mathbf{x} \in \mathbb{R}$, then $\nabla_{\mathbf{w}} f$ =?.

   (d) (10 pts) If $f = \mathbf{w}^T \cdot \mathbf{w} \in \mathbb{R}$, then $\nabla_{\mathbf{w}} f$ =?.

   Answer:

3. Statistics (20 pts)

   (a) (5 pts) Let A and B be two random variables. If A and B are independent, $P(A, B)$ =?

   (b) (10 pts) Suppose $P(A)$, $P(B)$, $P(A, B)$ are known. If A and B are independent, $P(A|B)$ =?.

   (c) (5 pts) Given $p(x)$ following the Gaussian distribution $\mathcal{N}(\mu = 0, \sigma = 5)$, for $p(1)$ and $p(2)$, which value is larger and why?

   Answer:

4. Neural Networks (30 pts)

   (a) (15 pts) Give the name of a training algorithm for deep learning.

   (b) (15 pts) Draw the curve of function $f(x) = \frac{1}{1+\exp(-x)}$.

   Answer: