CS691 Quiz 1 Name Solution & Rubric

1. **A** and **B** are 2x2 matrices. $\mathbf{A} \neq \mathbf{B}$.
Does **AB=BA**, always, sometimes, or never? Circle one and prove it. (3 points)

always/never -3

$$\begin{bmatrix} a & b \\ b & a \end{bmatrix}\begin{bmatrix} b & a \\ a & b \end{bmatrix} = \begin{bmatrix} 2ab & a^2+b^2 \\ b^2+a^2 & 2ab \end{bmatrix}$$

A B

any a & b work.

also need negative example

$$\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}\begin{bmatrix} 0 & 0 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 1 & 1 \end{bmatrix}.$$

10/w wrong positive example -1

$$\begin{bmatrix} b & a \\ a & b \end{bmatrix}\begin{bmatrix} a & b \\ b & a \end{bmatrix} = \begin{bmatrix} 2ab & a^2+b^2 \\ a^2+b^2 & 2ab \end{bmatrix}$$

10/w wrong neg example -1

2. Find the gradient of f. Show your work. (2 points)

$$f(x, y, z) = x^2yz^3 + 5xz + 3y^2 + z + 10$$

one mistake -1

no work -1

$$\frac{\partial f}{\partial x} = 2xyz^3 + 5z$$

$$\frac{\partial f}{\partial y} = x^2z^3 + 6y$$

$$\frac{\partial f}{\partial z} = 3x^2yz^2 + 5x + 1$$

$$\nabla f = \left(2xyz^3 + 5z,\ x^2z^3 + 6y,\ 3x^2yz^2 + 5x + 1\right)$$

3. I want a model that can predict the cost of gas. Is this a classification or regression problem? Why? (2 points)

classification -2

Predict a real value given past data.

no "real value" -1

-1 -1 -1

4. Show that **A** and **B** are orthogonal. Find another vector **C** that is orthogonal to **A**, such that $||\mathbf{C}||_2 = 1$. Show your work. (3 points)

-1

answer correct but no work -1

$$A = \begin{bmatrix} 8 \\ 4 \\ 2 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ -2 \\ 0 \end{bmatrix} \tag{1}$$

$$A \cdot B = \begin{bmatrix} 8 \\ 4 \\ 2 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ -2 \\ 0 \end{bmatrix} = 8 - 8 + 0 = 0 \checkmark$$

Dot product $\emptyset$ therefore $A \perp B$.

do not give -1/3 on this problem.

Find vector parallel to B w/ $||C||_2 = 1$.

Make B a unit vector.

$$C = \frac{B}{||B||_2} = \frac{\begin{bmatrix} 1 \\ -2 \\ 0 \end{bmatrix}}{\sqrt{1+2^2}} = \begin{bmatrix} \frac{1}{\sqrt{5}} \\ \frac{-2}{\sqrt{5}} \\ 0 \end{bmatrix} \checkmark$$

Any vector $\perp A$ and unit would

CS491 Quiz 1 Name Solution & Rubric

1. Are the following matrices inverses? Prove it. (3 points)

$$\begin{bmatrix} -24 & 18 & 5 \\ 20 & -15 & -4 \\ -5 & 4 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{bmatrix} \quad (2)$$

-1 for each math mistake

$$\begin{bmatrix} -24+25 & -48+18+30 & -72+72+0 \\ 20-20 & 40-15-24 & 60-60 \\ -5+5 & -10+4+6 & -15+16+0 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad \text{yes} \checkmark$$

2. Find the gradient of f at (1,2,1). Show your work. (3 points)

$$f(x, y, z) = x^2yz^3 + 5xz + 3y^2 + z + 10$$

Same #2 ← ~~df/dx~~ Same as #2 691

-1 if they don't get this → (9, 13, 12)

3. Are the following vectors orthogonal? How do you know? Show your work. (2 points)

$$\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} \begin{bmatrix} 6 \\ -3 \\ 1 \end{bmatrix} \quad (3)$$

$6 \cdot 1 + 2 \cdot -3 + 3 \cdot 1$

$6 - 6 + 3 = 3$

-1 yes

-1 how do you know No Because the dot-product in nonzero.

-1 no show work Minimum: 0/2

4. What does it mean for a model to be *generalizable*? (2 points)

-1 if they don't Perform well on unseen data.

Say anything about either unseen or held out or test data.

-2 if nonsense