

**CSCE 5563**  
**Introduction to Deep Learning**  
**Homework 0: 0 pts (no grading)**

1. Find a, b, T in the such as:

$$\begin{aligned} ax + by + T &> 0 \text{ if } (x,y) = (1,1) \\ ax + by + T &< 0 \text{ if } (x,y) = (0,1) \text{ or } (1,0) \text{ or } (0,0) \end{aligned}$$

2. Find a, b, T in the such as:

$$\begin{aligned} ax + by + T &> 0 \text{ if } (x,y) = (1,1) \text{ or } (0,1) \text{ or } (1,0) \\ ax + by + T &< 0 \text{ if } (x,y) = (0,0) \end{aligned}$$

3. Find a, b, T in the such as:

$$\begin{aligned} ax + by + T &> 0 \text{ if } (x,y) = (1,0) \text{ or } (0,1) \\ ax + by + T &< 0 \text{ if } (x,y) = (1,1) \text{ or } (0,0) \end{aligned}$$

4. Given an image  $3 \times 3$   $f = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$  and a kernel  $g = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 91 \end{bmatrix}$ .

- What is the convolution of f and g
- What is the correlation of f and g

5. Given two vector:  $\mathbf{v} = [1,0,5]$  and  $\mathbf{w} = [0, 2, 4]$ . What is the distance between  $\mathbf{v}$  and  $\mathbf{w}$  using following metrics
- L2 norm
  - L1 norm
  - L0 norm

6. Compute the derivative of the following functions:

- $f(x) = 3x$
- $f(x) = x^3$
- $f(x) + g(x)$  where  $f(x) = x^2 + 3x$
- $f(x)g(x)$  where  $f(x) = x^2$  and  $g(x) = x$
- $f(g(x))$  where  $f(x) = \ln(x)$  and  $g(x) = x^2$

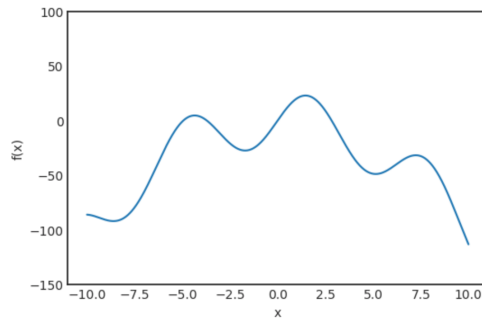
7. What is partial derivatives  $\frac{\partial f(x,y)}{\partial x}$  and  $\frac{\partial f(x,y)}{\partial y}$  of the following function:

- $f(x,y) = 3x^2y$ .
- $f(x,y) = 2x + y^8$ .

8. Compute Jacobian matrix of  $f(x,y) = 3x^2y$  and  $g(x,y) = 2x + y^8$

9. Given  $f(x,y) = x^3 - 2xy - y^6$ . Compute Hessian at point (1,2)

10. Given  $f(x) = 25\sin(x) - x^2$  which looks like the following graph. Imagine that this is a mountain landscape and you are climbers, trying to reach the valley



- a. For any point  $x, y$  on the function, what is the slope defined?
- b. For any point  $x, y$  on the function, what is the tangent defined?
- c. If you start at  $x_0 = -5.0$ , which direction you should go to reach the valley in 2 cases: slope is increasing and slope is decreasing.
- d. Choose any  $y$ , draw tangent and slope at  $x_0$