

## DS 542 - Fall 2025 - Homework 1

Feel free to write your answers by hand. No need for LaTeX; just make sure it is legible.

1. Equation 2.5 in the textbook (Understanding Deep Learning) gives the equation for linear regression with one input variable using the least-squares loss.

$$\begin{aligned} L[\phi] &= \sum_{i=1}^I (f[x_i, \phi] - y_i)^2 \\ &= \sum_{i=1}^I (\phi_0 + \phi_1 x_i - y_i)^2 \end{aligned}$$

- (a) Derive the formula for  $\partial L / \partial \phi_0$ .

- (b) Derive the formula for  $\partial L / \partial \phi_1$ .

2. Answer the following questions about the following equation.

$$\begin{bmatrix} 1 & 5 \\ 2 & 3 \end{bmatrix} \begin{bmatrix} 3 & 2 \\ 4 & 0 \end{bmatrix} = \begin{bmatrix} x_{0,0} & x_{0,1} \\ x_{1,0} & x_{1,1} \end{bmatrix}$$

(a) What is the mathematical operation on the lefthand side of the equation?

(b) Write out the formula to calculate  $x_{1,0}$ .

3. Answer the following questions about ordinary least squares linear regression.

(a) What is the mean residual on the training data?

(b) Why?