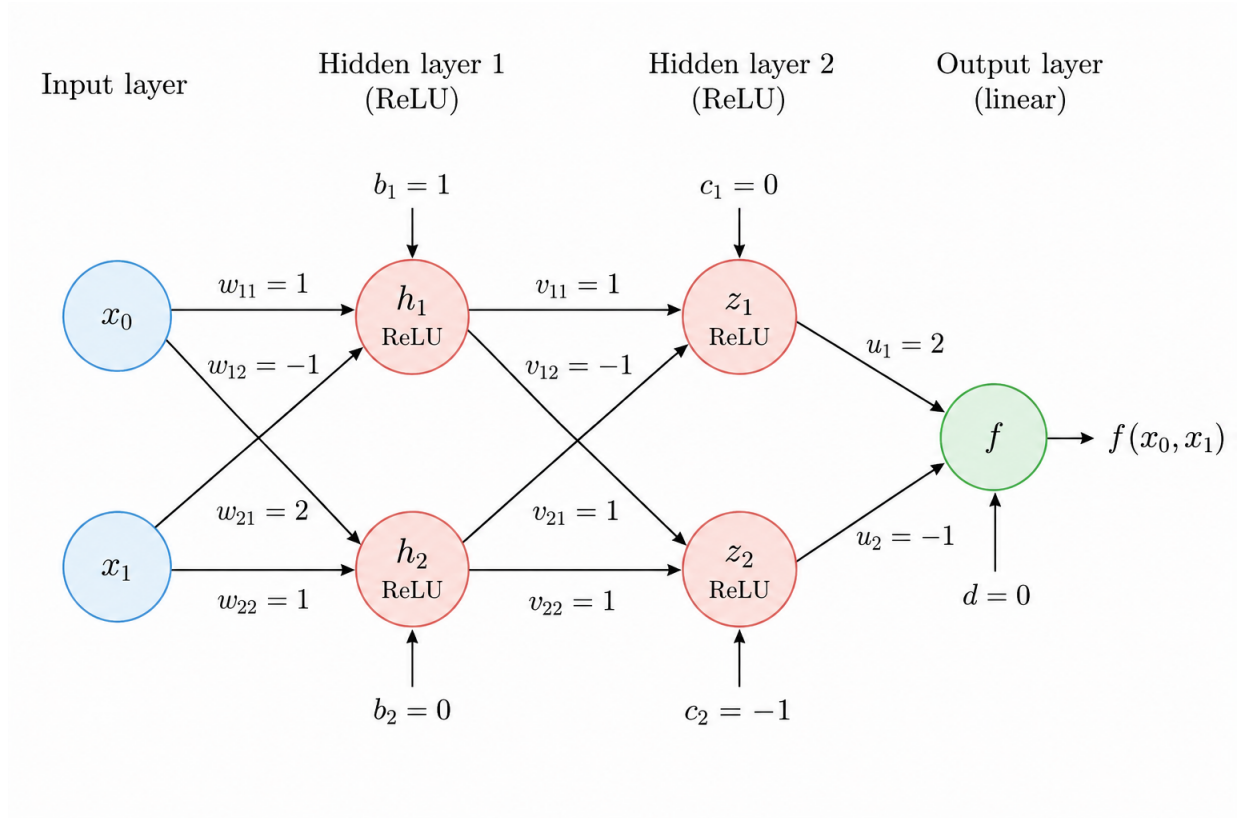


Homework 1

Problem 1 (2pts). The following feed-forward neural network uses ReLU activation in its hidden layers. Write the function $f(x_0, x_1)$ represented by the network explicitly in terms of x_0, x_1 . Evaluate $f(1, -1)$



Problem 2 (4pts). Let

$$f(x) = \sum_{j=1}^3 c_j \operatorname{ReLU}(w_j x + b_j).$$

where

$$c_j \neq 0, w_j \neq 0, j = 1, 2, 3$$

(a)[1pt] what are the locations of the kinks?

(b)[3pts] Under what conditions of the coefficients does f have exactly:

- no kink;
- one kink;
- two kinks;
- three kinks?

Please list all possible conditions.

Problem 3 (4pts). *Let*

$$f(x) = \begin{cases} 0, & x \leq -1, \\ x + 1, & -1 < x \leq 0, \\ 1 - x, & 0 < x \leq 1, \\ 0, & x > 1. \end{cases}$$

$$g(x_0, x_1) = \frac{1}{1 + \exp\left(-\left[\frac{1}{1+e^{-x_0}} + \frac{1}{1+e^{-x_1}} - 1\right]\right)}.$$

$$h(x_0, x_1) = \begin{cases} 1, & 0 < x_0 < 1 \text{ or } -1 < x_1 < 2, \\ 0, & \text{otherwise.} \end{cases}$$

Construct three feed-forward neural networks that represent f , g , and h , respectively, choosing an appropriate activation function for each network. Draw each network and specify all weights and biases.