

ECE/CS 559 - Fall 2022  
Homework #1  
Due: 09/09/2022, 11:00pm.

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- You are allowed to discuss the homework problems with your classmates, but you are supposed to do your assignment individually.
- Submit your solutions to Gradescope. Late submissions will be penalized.

1. **(50 pts)** Design a two-layer neural network with the **signum activation function** (i.e.  $\text{sgn}(x) = 1$  if  $x > 0$ ,  $\text{sgn}(x) = -1$  if  $x < 0$ , and  $\text{sgn}(0) = 0$ ) such that the network implements the logic gate  $f(x_1, x_2, x_3) = \overline{x_1}x_2x_3 + x_1\overline{x_2}$ . Assume that the input of  $-1$  is used to represent a **FALSE**, and an input of  $1$  is used to represent a **TRUE**. Show your work and draw the final network. Note that in class, we have discussed examples where we have instead used the step activation function and a  $0$  for **FALSE**.
2. **(50 pts)** Consider the network in Fig. 1. In the  $x - y$  plane, sketch the region where  $z = 1$ . Show your work. Make sure you correctly indicate which part of the boundaries belong to the region  $z = 1$ . Recall that  $u(x) = 1$  if  $x \geq 0$  and  $u(x) = 0$  if  $x < 0$ .

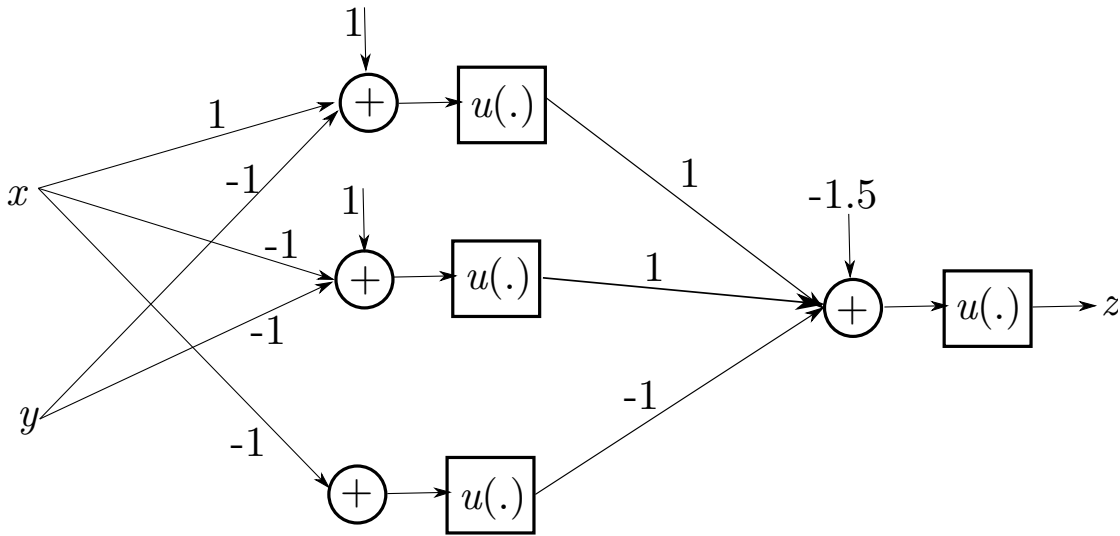


Figure 1: The neural network for Problem 2.