ECE/CS 559 - Fall 2023
Homework #1
Due: 09/12/2023, 11:00pm.

- You are allowed to discuss the homework problems with your classmates, but you are supposed to do your assignment individually.

- Submit your HW report to Gradescope and your codes to the Code folder in Box. Late submissions will be penalized according to the Syllabus.

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. Write a Python program that draws 1000 points uniformly at random from the square $[-2, 2]^2$ and feeds each point to the neural network. If the network output is 0, plot the corresponding point as a blue point, and otherwise as a red point. Include your code together with your plot. Provide your estimate of the decision region that separates the output of 0 from an output of 1. Upload your code as a single .py file 01-IDNUMBER-YOURLASTNAME.py to the codes folder. Jupyter notebook, etc are not allowed. Your code should simply run when I type python (or python3) 01-IDNUMBER-YOURLASTNAME.py
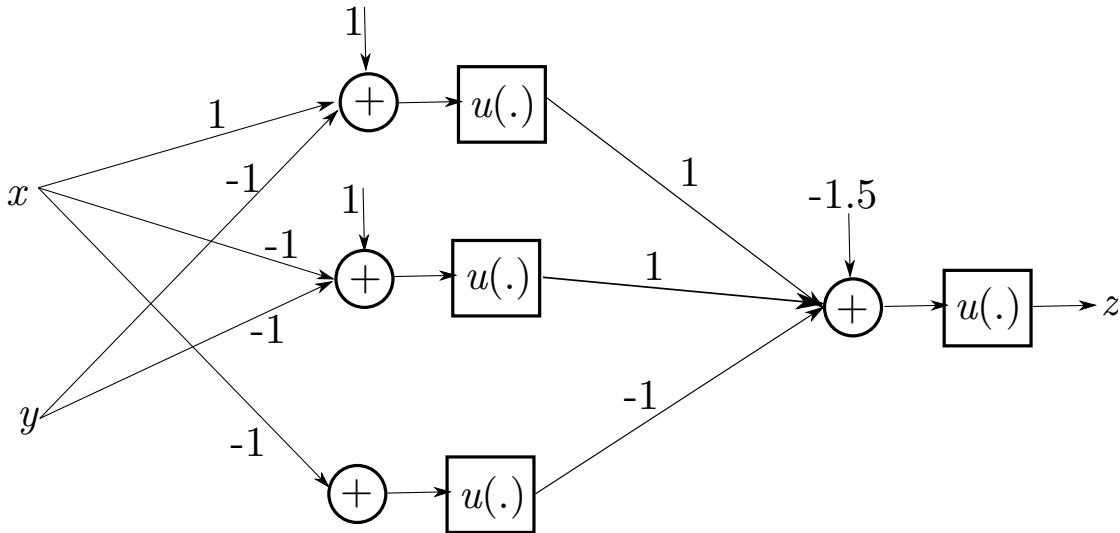

Figure 1: The neural network for Problem 2.