EEE 443/543 - Spring 2025
Project #1
Due: 02/14/2025, 11:00pm.

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

- Submit one and only one PDF file, which will consist of all written portions of your assignment to the P1-Reports folder as 01-IDNUMBER-YOURLASTNAME.pdf.

- Submit one and only one py file, which will be the requested code of your assignment to P1-Codes folder as 01-IDNUMBER-YOURLASTNAME.py. Jupyter notebook, etc are not allowed. Your code should simply run when I type python (or python3) 01-IDNUMBER-YOURLASTNAME.py

- 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 $f(x_1, x_2, x_3) = \overline{x_1} x_2 x_3 + x_1 \overline{x_2}$. 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. Provide the plot in your report. Provide your estimate of the decision region that separates the output of 0 from an output of 1. Upload your code as instructed.
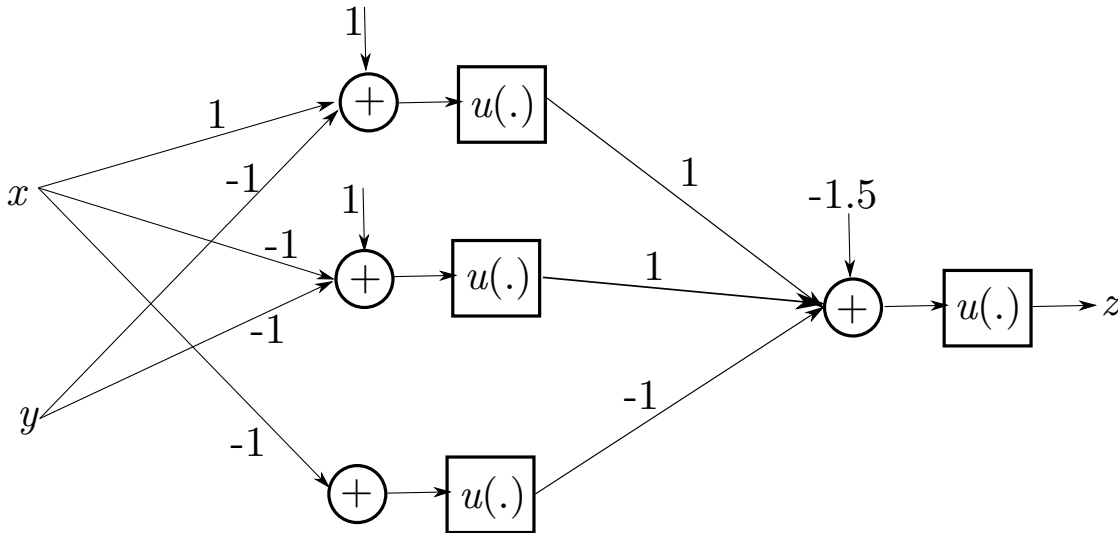

Figure 1: The neural network for Problem 2.