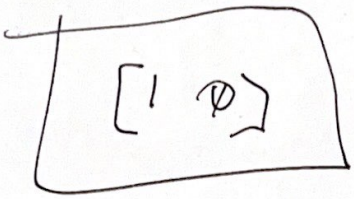
## Part 3: Long Answer

3. (12 points) Suppose you have the following training points for classification; points are listed as $(x_1, x_2, y)$:

(1, 0, +)
(1, 1, +)
(0, 1, −)

a. (6 points) Execute one pass of perceptron on this data, starting from a weight vector initialized at 0 and using the decision rule of $\mathbf{w}^\top \mathbf{x} > 0$ (that is, classifying as positive if the score is greater than 0). What is the final weight vector you get? **Box your final answer.**

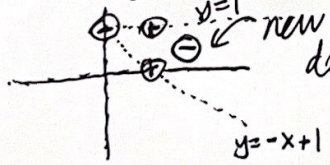
start [0 0] -
(1 0] +
[1 0] -
[1 0]




b. (4 points) Suppose we add a 4th point to the training set with a negative class label. Mathematically describe the region in the x feature space where, if this example is added, the perceptron *will not converge*. You may either give your answer as a set of mathematical constraints, draw a picture, or describe in words, as long as you are precise.

If we add a negative example such that the negatives and positives are no longer linearly separable, perceptron will not converge.

Example:




new negative example in region between dotted lines

c. (2 points) Now suppose we add the point (4, 2, -). Does there exist a neural network (with any depth, any nonlinearity, and any width) that would classify all of these points correctly? Briefly justify your answer.

yes, there is still a line in the 2D plane that separates these examples.