

**Exercise on Classification**

Given the following dataset where  $x = \{x_0, x_1, x_2\}$  is the input vector and  $y$  is the true label:

$x_0$	$x_1$	$x_2$	$y$
1	1	-1	1
1	1	1	1
1	-1	1	1
1	-1	-1	-1

The initial values of the weight vector  $\mathbf{w}$  are set to be  $[-1, -1, -1]^T$ .

- 1) Run through the perceptron algorithm by filling in the following table until the weight vector  $\mathbf{w}$  converges.

Iteration #	$\mathbf{w}$ (old)	$\mathbf{x}$	$y$	$y(\mathbf{w}^T \mathbf{x})$	Update (Y/N)	$y\mathbf{x}$	$\mathbf{w}$ (new)
1	$[-1, -1, -1]$	$[1, 1, -1]$	1	-1	Y	$[1, 1, -1]$	$[0, 0, -2]$
2	$[0, 0, -2]$	...					
3							
4							
5							

- 2) Write down the equation of the decision boundary.
- 3) Plot the decision boundary of the perceptron.
- 4) Assume that the initial values of the weight vector  $\mathbf{w}$  are  $[0.3, 0.5, 0.5]$ . Repeat 1-3.

Iteration #	$\mathbf{w}$ (old)	$\mathbf{x}$	$y$	$y(\mathbf{w}^T \mathbf{x})$	Update (Y/N)	$y\mathbf{x}$	$\mathbf{w}$ (new)
1							
2							
3							
4							
5							

- 5) Compare the two decision boundaries obtained and discuss which is better.