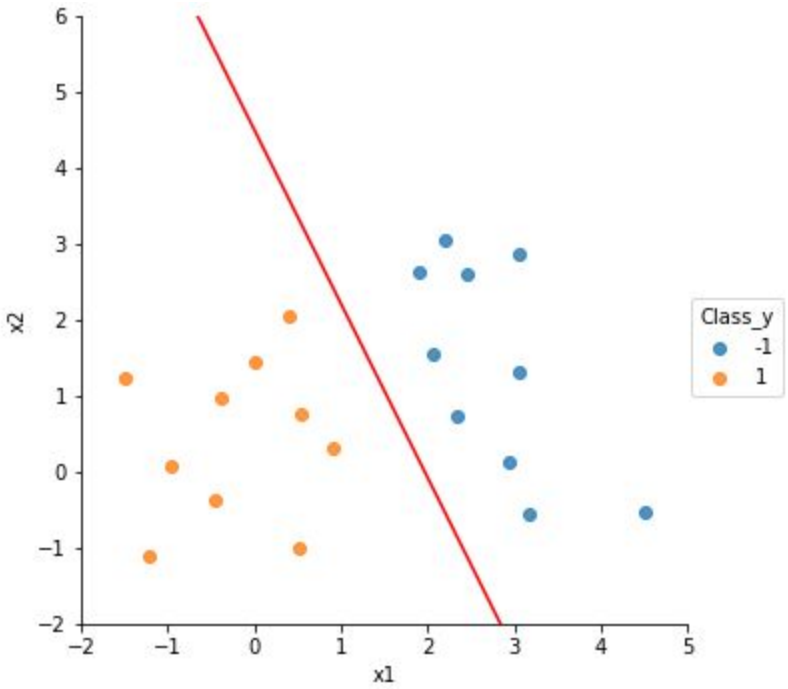
1. **Support Vector Machine**
   a. Please point out the support vectors in the training points.
      i. Point 2: $x_1 = 0.91,\ x_2 = 0.32$
      ii. Point 18: $x_1 = 2.05,\ x_2 = 1.54$
      iii. Point 19: $x_1 = 2.34,\ x_2 = 0.72$
   b. $w = 0.9492 * [0.91\ 0.32]^T - 0.3030 * [2.05\ 1.54]^T - 0.9053 * [2.34\ 0.72]^T$
      $w = [0.86\ 0.30]^T - [0.62\ 0.47]^T - [2.12\ 0.65]^T$
      $w = [-1.88\ -0.72]^T$
   c. $b = \frac{1}{3}((1 + [1.88\ 0.72] \cdot [0.91\ 0.32]^T) + (-1 + [1.88\ 0.72] \cdot [2.05\ 1.54]^T) + (-1 + [1.88\ 0.72] \cdot [2.34\ 0.72]^T)$
      $b = \frac{1}{3}((1 + 1.97) + (-1 + 5.12) + (-1 + 4.99))$
      $b = 3.69$
   d. $f(x) = [-1.88\ -0.82]x + 3.69$
   e. $f([-1\ \ 2]) = [-1.88\ -0.82] \cdot [-1\ \ 2]^T + 3.69$
   f. Plot of hyperplane:



2. **Artificial Neural Network**
   a. Parameters: $P + 3P + 3 + 12 + 4 + 4K = 4P + 4K + 19$
   b.

Unit, j	Net Input I_j	Output O_j
3	-0.3(0)+0.4+0.2 = **0.6**	**0.65**
4	0.2(0)-0.1-0.4 = **-0.5**	**0.38**

5	0.2(0.65)-0.3(0.38)+0.1 = **-0.144**	**0.46**

c.

Unit, j	Err_j
5	(0.46)(1-0.46)(1-0.46) = **0.13**
4	(0.38)(1-0.38)(0.13)(-0.3) = **-0.0092**
3	(0.65)(1-0.65)(0.13)(-0.2) = **-0.0059**

d.

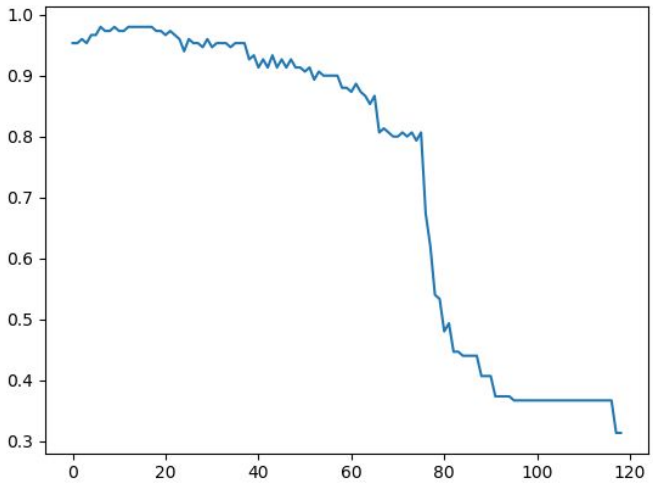
Weight or Bias	New Value
w_{35}	-0.2 + 0.8(0.13)(0.65) = **-0.1324**
w_{45}	-0.3 + 0.8(0.13)(0.38) = **-0.26**
w_{13}	-0.3 + 0.8(-0.0059)(0) = **-0.3**
w_{14}	0.2 + 0.8(-0.0092)(0) = **0.2**
w_{23}	0.4 + 0.8(-0.0059)(1) = **0.395**
w_{24}	-0.1 + 0.8(-0.0092)(1) = **0.107**
θ_5	0.1 + 0.8(0.13) = **0.204**
θ_4	-0.4 + 0.8(-0.0092) = **-0.407**
θ_3	0.2 + 0.8(-0.0059) = **0.195**

e.

3. K Nearest Neighbors

a. K = 7

b. K-Value vs Average Accuracy



c. We are performing cross validation and if K is large we overfit and are unable to classify other folds correctly. When K is smaller we have a model that is more general and so is more accurate.