Chenrui Xu. HW4.

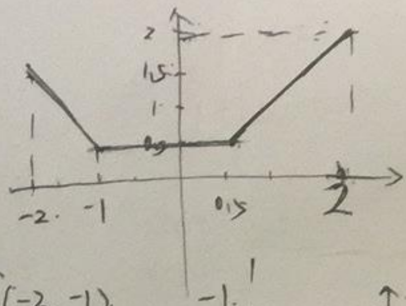
1. ① $y=\underline{-P+0.5}\geq 0 \quad P\leq 0.5$ $\quad \begin{cases} -P+0.5 & (-2, 0.5] \\ 0 & (0.5, 2) \end{cases}$

② $y=P+1 \geq 0 \quad P\geq -1$ $\quad \begin{cases} 0 & (-2,-1) \\ P+1 & [-1, 2) \end{cases}$

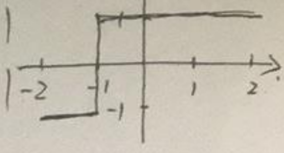
when $(-2,-1)$. $1\times(-P+0.5)+0-1=-P-0.5$

$[-1,0.5]$ $1\times(-P+0.5)+(P+1)\times 1-1=0.5$

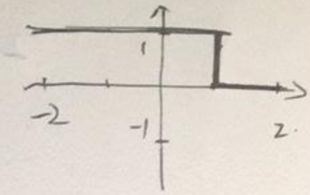
$(0.5,2)$ $0\times 1+(P+1)\times 1-1=P$



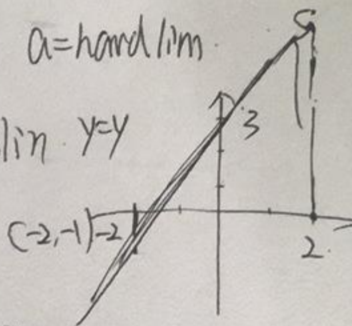
2. ① $y=P+1$ $a=$ hardlims. $P+1\geq 0$ $P\geq -1$ $\begin{cases} (-2,-1) & -1 \\ [-1,2) & 1 \end{cases}$



② $y=-P+1\geq 0$ $P\leq 1$. $a=$ hardlim. $\quad 1 \quad (-2,1]$; $0 \quad (1,2)$

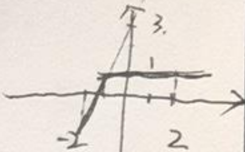


③ $y=2P+3$ $a=$ purelin. $y=y$ $\quad (2,7)$

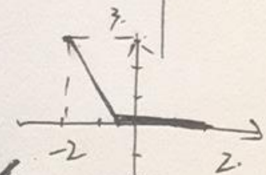


④ $y=2P+3$. $\underline{a=\text{satlins}}$. $2P+3\leq -1$ $P\leq -2$. -1.

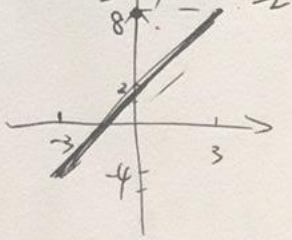
$2P+3\geq 1$ $P\geq -1$ $\quad 1$. $\quad \begin{cases} -1 & \times \\ 1 & (-1,2) \\ 2P+3 & (-2,-1] \end{cases}$



⑤ $y=-2P-1$ $a=$ poslin. $-2P-1\geq 0$ $P\leq -\frac{1}{2}$. $\quad \begin{cases} -2P-1 & (-2,-\frac{1}{2}] \\ 0 & (-\frac{1}{2}, 2) \end{cases}$



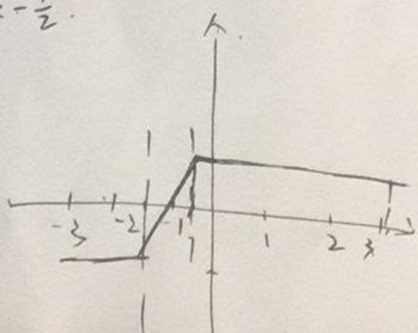
3. ① $y=2P+2$. $P\in(-3,3)$ $-3\times 2+2=-4$. $2\times 3+2=8$



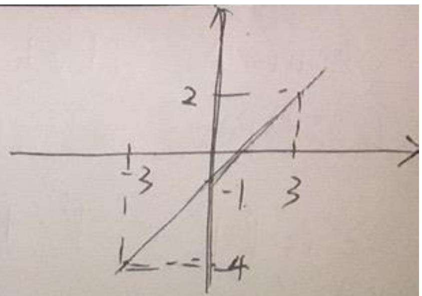
② $a=$ satlins. $2P+2\geq 1$. $P\geq -\frac{1}{2}$

$2P+2\leq -1$. $P\leq -\frac{3}{2}$.

$\begin{cases} -1 & (-3, -\frac{3}{2}] \\ 2P+2 & (-\frac{3}{2}, -\frac{1}{2}) \\ 1 & [-\frac{1}{2}, 3) \end{cases}$



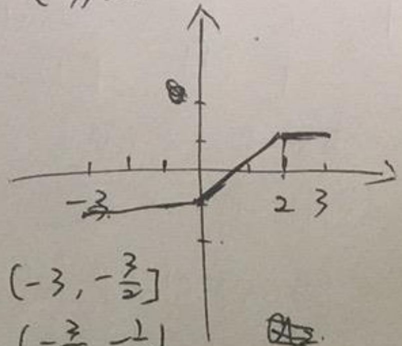
③ $y = p - 1. \quad p \in (-3, 3).$



④ $a = \text{satlins} \quad p-1 \geq 1. \quad p \geq 2. \quad [2, 3)$

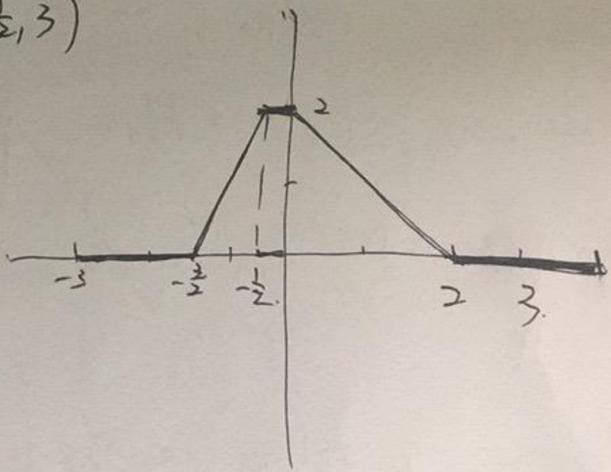
$p-1 \leq -1. \quad p \leq 0 \quad (-3, 0]$

$$\begin{cases} -1 & [-3, 0] \\ p-1 & (0, 2) \\ 1 & [2, 3) \end{cases}$$



⑤ $\underline{a_1 - a_2}$ recall a_1 $\begin{cases} -1 & (-3, -\frac{3}{2}] \\ 2p+2 & (-\frac{3}{2}, -\frac{1}{2}) \\ 1 & [-\frac{1}{2}, 3) \end{cases}$

$$y_2 = a_1 - a_2 = \begin{cases} 0 & (-3, -\frac{3}{2}] \\ +2p+3 & (-\frac{3}{2}, -\frac{1}{2}) \\ 2 & [-\frac{1}{2}, 0] \\ 2-p & (0, 2) \\ 0 & [2, 3) \end{cases}$$



⑥ $a = \text{purelin}, \quad y_2 = y_2.$

same as ⑤

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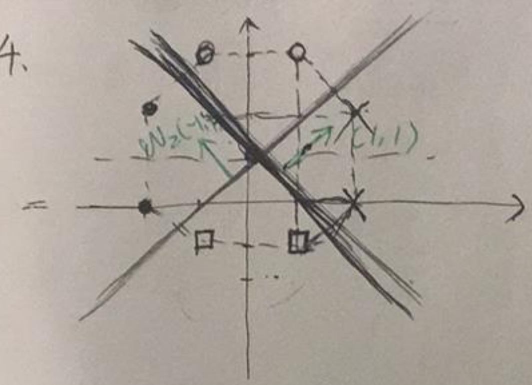
4.



i) let W_1 (1, 1) (1, 0) on DB.

$(1,1)\begin{pmatrix}1\\0\end{pmatrix} + b_1 = 0$

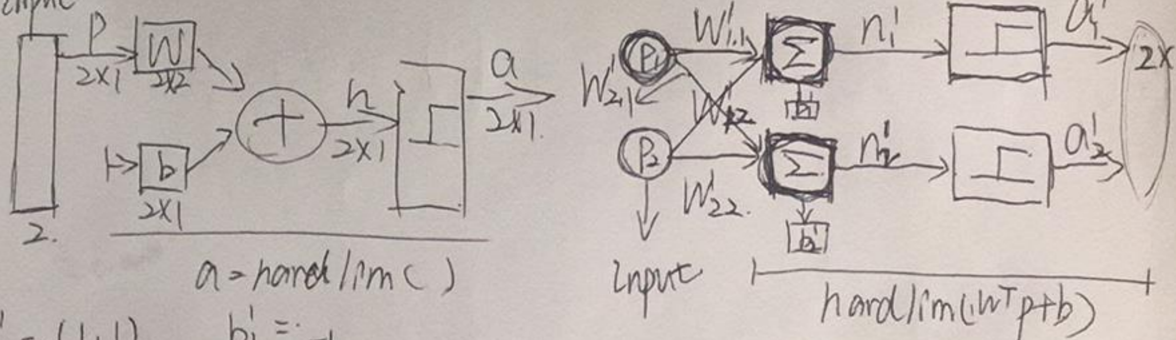
$1 + b = 0$ $b_1 = -1$.

let W_2 (-1,1) (-1,0) on DB

$(-1,1)\begin{pmatrix}-1\\0\end{pmatrix} + b_2 = 0$ $b_2 = -1$

We choose two different kinds of category points which are close to each other. then we get the mid-point of it. Connect two mid-points twice to get two lines. As those four category points distributed very well, the distances between DB and points (if use mid-point and orthogonal line). are same. So it can be the best one.

ii) input



$W_1' = (1,1)$ $b_1' = -1$

$W_2' = (-1,1)$ $b_2' = -1$

iii) $(1,1)\begin{pmatrix}-3\\1\end{pmatrix} - 1 = -3 < 0$ V

$(-1,1)\begin{pmatrix}-3\\1\end{pmatrix} - 1 = 3 > 0$ X

$\Rightarrow e = t - a = -1$

$w^{new} = w^{old} - p = \begin{pmatrix}-1\\1\end{pmatrix} - \begin{pmatrix}-3\\1\end{pmatrix} = \begin{pmatrix}2\\0\end{pmatrix}$ $b^{new} = b^{old} + e_i = -1-1 = -2$

~~$(2,0)\begin{pmatrix}-3\\1\end{pmatrix} - 1 = -6-1 = -7 < 0$ V~~

$(2,0)\begin{pmatrix}-3\\1\end{pmatrix} - 2 = -8 < 0$ V

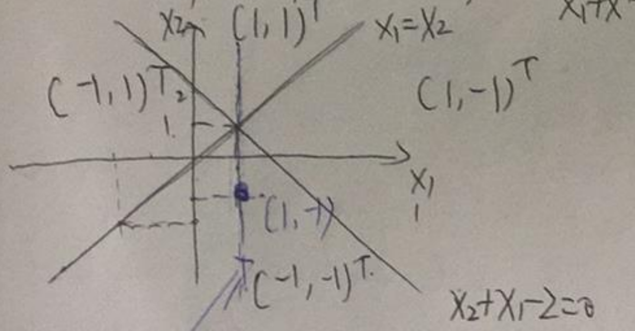
5. (i) According to $a = \text{hardlims}(Wp+b)$ $a = \pm 1$.

$W = \begin{pmatrix} 1 & 1 \\ -1 & 1 \end{pmatrix}$ $S=2$, so $(a_1\ a_2)$. a_1 have two classes a_2 have 2 classes

$2^2 = 4$ so there're four categories

(ii). $\begin{pmatrix} 1 & 1 \\ -1 & 1 \end{pmatrix}\begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \begin{pmatrix} -2 \\ 0 \end{pmatrix} = \begin{pmatrix} x_1+x_2-2 \\ -x_1+x_2 \end{pmatrix}$ $x_1+x_2-2 \geq 0$ $a_1 = 1$ | $-x_1+x_2 \geq 0$ $a_2 = 1$

$x_1+x_2-2 < 0$ $a_1 = -1$ | $-x_1+x_2 < 0$ $a_2 = -1$



(iii). $\begin{pmatrix} 1 & 1 \\ -1 & 1 \end{pmatrix}\begin{pmatrix} 1 \\ -1 \end{pmatrix} + \begin{pmatrix} -2 \\ 0 \end{pmatrix} = \begin{pmatrix} -2 \\ -2 \end{pmatrix}$ $\begin{matrix} -2 < 0 \\ -2 < 0 \end{matrix} \Rightarrow \begin{pmatrix} -1 \\ -1 \end{pmatrix}$

(iv). Blue point in the region of $\begin{pmatrix} -1 \\ -1 \end{pmatrix}$ category.