

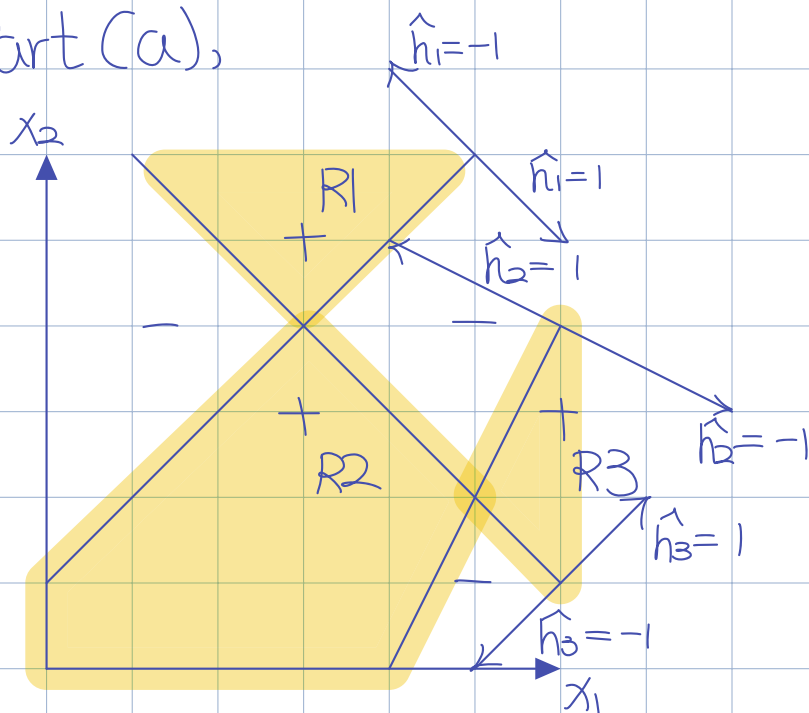
ECE421 Homework 5

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Question 1

Part (a),



Region R_1 , $f_{R1} = \overline{h_1} h_2 h_3$
Region R_2 , $f_{R2} = h_1 h_2 \overline{h_3}$
Region R_3 , $f_{R3} = h_1 \overline{h_2} h_3$ } + Prediction

$$f = \overline{h_1} h_2 h_3 + h_1 h_2 \overline{h_3} + h_1 \overline{h_2} h_3$$

Part (b),

Step 1, Assign label to each hyperplane h_i

Step 2, Based on f , pick one side of h_i as $+$ and the other as $-$

Step 3, For each $f = +1$ region find the sign of the corresponding half-space for each hyperplane, AND all h_i , negate any h_i if the half-space is $-$

Step 4, OR all terms

Question 2,

Part (a),

Two Input Case

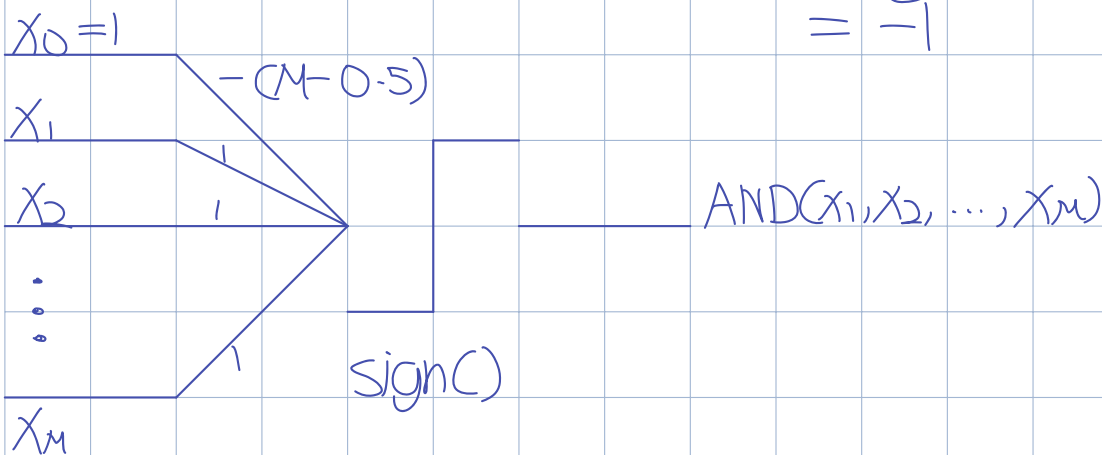
$$\text{OR}(x_1, x_2) = \text{sign}(x_1 + x_2 + 1.5)$$

x_1	x_2	$x_1 + x_2 + 1.5$	$\text{sign}()$	$0 \rightarrow -1$ $1 \rightarrow +1$
-1	-1	-0.5	-1	
-1	+1	1.5	+1	
+1	-1	1.5	+1	
+1	+1	2.5	+1	

$$\text{AND}(x_1, \dots, x_M) = \text{sign}(x_1 + \dots + x_M - (M - 0.5))$$

$$\begin{aligned} \text{If } x_1 = x_2 = \dots = x_M = 1 &\longrightarrow \text{sign}(M - (M - 0.5)) \\ &= \text{sign}(0.5) \\ &= +1 \end{aligned}$$

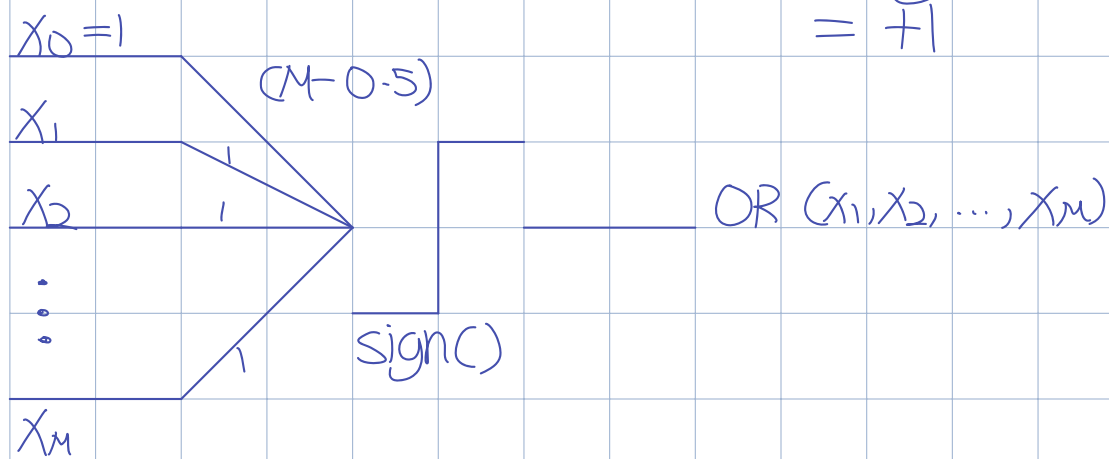
$$\begin{aligned} \text{If } x_1 = -1, x_2 = \dots = x_M = 1 &\longrightarrow \text{sign}(-1 + (M - 1) - (M - 0.5)) \\ &= \text{sign}(-1.5) \\ &= -1 \end{aligned}$$



$$\text{OR}(x_1, \dots, x_M) = \text{sign}(x_1 + \dots + x_M + (M - 0.5))$$

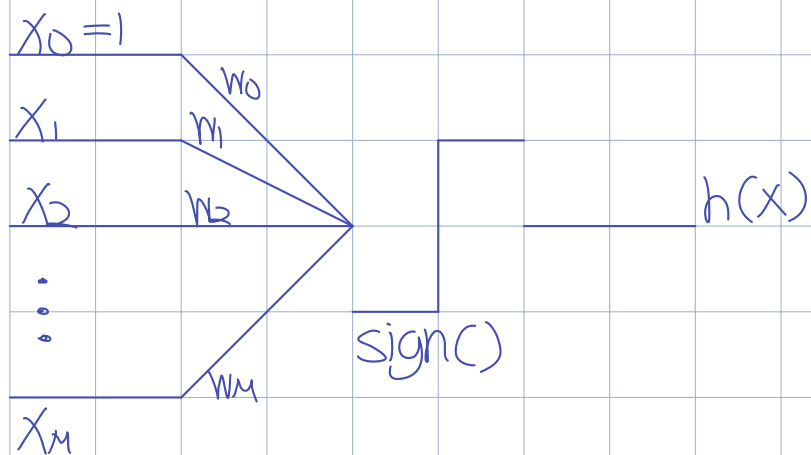
$$\begin{aligned} \text{If } x_1 = x_2 = \dots = x_M = -1 &\longrightarrow \text{sign}(-M + (M - 0.5)) \\ &= \text{sign}(-0.5) \\ &= -1 \end{aligned}$$

$$\begin{aligned} \text{If } x_1 = +1, x_2 = \dots = x_M = -1 &\longrightarrow \text{sign}(1 - (M-1) + (M - 0.5)) \\ &= \text{sign}(1 - 5) \\ &= +1 \end{aligned}$$



Part (b),

$$h(x) = \text{sign}(w^T x) = \text{sign}(x_0 w_0 + x_1 w_1 + \dots + x_M w_M)$$



Part (c),

$$\begin{aligned} \text{OR}(x_1, \overline{x_2}, x_3) &= \text{sign}(x_1 + \overline{x_2} + x_3 + (3 - 0.5)) \\ &= \text{sign}(x_1 + \overline{x_2} + x_3 + 2.5) \\ &= \text{sign}(x_1 - x_2 + x_3 + 2.5) \end{aligned}$$

