CMSC 422 — Assignment 1 — Martin Iglesias

(1) $\text{dtpt} = \bar{a}_r = \{0,1\}$ $n = 1000$ → Correct

		Predictions 1	Predictions 0
Target Classes	1:	1/3	0/11
	0:	2	84

} for $n = 100$

a) Confusion matrix

b) # Errors for 1 = 11 # Errors for 0 = 2 # total Errors = 13

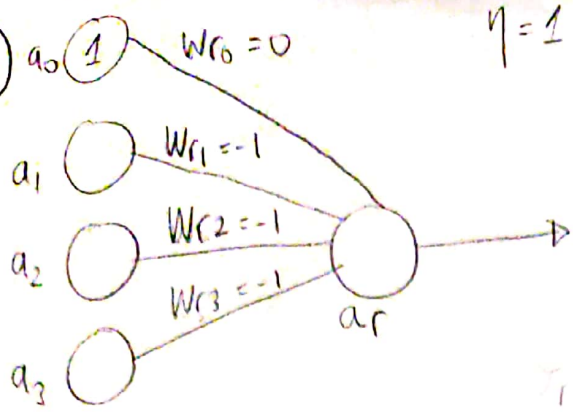
Sample error rate = $13/100 = \boxed{0,13} = E_S$

c) Same as b) because $n \geq 30 \Rightarrow \boxed{0,13} = E_S$

d) 95% Confidence interval is $E_S \pm 1,96 \sqrt{\frac{0,13(1-0,13)}{100}} = \boxed{0,13 \pm 0,0659}$

e) sensitivity (1) = $\frac{3}{5} = \boxed{0,6}$

f) Specifity (1) = $84/95 = \boxed{0,884}$

(2) 

$\eta = 1$

this correct?

$$\begin{cases} 0 & \text{if } in_r \le \theta_r = 0 = Wr_0 \\ 1 & \text{if } in_r > \theta_r = 0 = Wr_0 \end{cases}$$

a) Wr_i? $\quad \theta_r' = \theta_r + \eta(t_r - a_r)$

$Wr_i' = Wr_i + \Delta Wr_i = Wr_i + \eta(t_r - a_r)a_i$

B case

$t_r = 1$ $\quad in_r = [0,-1,-1,-1][1,1,1,1] = -3 < 0 \Rightarrow a_r = 0$

$Wr_0 = 0 + 1(1-0)(1) = 1 \quad Wr_1 = -1 + 1(1-0)1 = 0$

$Wr_2 = 0 \quad Wr_3 = 0 \quad \theta_r = 0 - (1-0) = -1$

So after showing B

$$\begin{cases} Wr_0 = 1 \quad Wr_1 = Wr_2 = Wr_3 = 0 \\ \theta_r = -1 \end{cases}$$

G Case Before G

θ_r ↓

Now $\begin{cases} t_r = 0 \\ in_r = [1,0,0,0][1,1,0,0] = 1 > -1 \Rightarrow a_r = 1 \end{cases}$

(w_0 w_1 w_2 w_3 ; a_0 a_1 a_2 a_3)

$Wr_0 = 1 + (0-1)(1) = 0 \quad Wr_1 = 0 + (0-1)(1) = -1$

$Wr_2 = 0 + (0-1)(0) = 0 \quad Wr_3 = 0$

$\theta_r = -1 - (0-1) = 0$

After G

$$\begin{cases} Wr_0 = Wr_2 = Wr_3 = 0 \\ Wr_1 = -1 \\ \theta_r = 0 \end{cases}$$

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(2)

b) Decission surface $\Rightarrow \boxed{\theta_r = 0}$

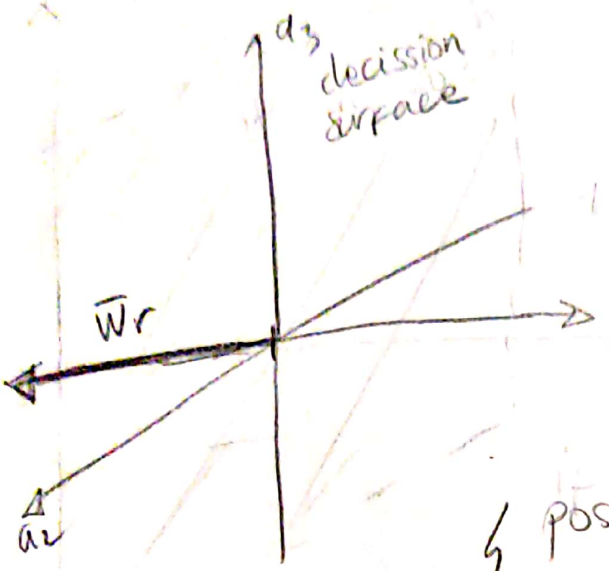
$\bar{w}_r = [0, -1, 0, 0]$
$w_0\ w_1\ w_2\ w_3$

$\bar{a} = [1, a_1, a_2, a_3]$

$in_{r=0} = [0,-1,0,0][1, a_1, a_2, a_3]$

$= -a_1 = 0 \therefore a_1 = 0$

plane $\begin{cases} a_2 = \alpha \\ a_3 = \lambda \end{cases}$ = decission surface



positive $a_1 \Rightarrow 1$
negative $a_1 \Rightarrow 0$

c) Yes

d) Perceptron convergence theorem

e) $w_0 + w_1 + w_2 + w_3 > 0$ if $t_r = 1$

$w_0 + w_1 + w_2 + w_3 \leq 0$ if $t_r = 0$

For A $\Rightarrow$ $w_0 + w_1 + w_2 + w_3 \leq 0 \Rightarrow w_0 \leq 0$ ①

B $\Rightarrow$ $w_0 + w_1 + w_2 + w_3 > 0 \Rightarrow -w_0 < w_1 + w_2 + w_3$ ②

C $\Rightarrow$ $w_0 + w_1^0 + w_2 + w_3 \leq 0 \Rightarrow -w_0 \geq w_3$ ③

D $\Rightarrow$ $w_0 + w_1 + w_2^0 + w_3 > 0 \Rightarrow -w_0 < w_1 + w_2$ ④

E $\Rightarrow$ $w_0 + w_1^0 + w_2 + w_3^0 \leq 0 \Rightarrow -w_0 \geq w_2$ ⑤

F $\Rightarrow$ $w_0 + w_1 + w_2^0 + w_3 > 0 \Rightarrow -w_0 < w_1 + w_3$ ⑥

G $\Rightarrow$ $w_0 + w_1 + w_2^0 + w_3^0 \leq 0 \Rightarrow -w_0 \geq w_1$ ⑦

H $\Rightarrow$ $w_0 + w_1^0 + w_2 + w_3 > 0 \Rightarrow -w_0 < w_2 + w_3$ ⑧

Say we do $w_0 = -1$ $w_1 = w_2 = w_3 = 1$ ✓ ✓

Therefore, ① ✗ ② ✓ ③ ✓ ④ ✓ ⑤ ✓ ⑥ ✓ ⑦ ✓ ⑧ ✓

$\therefore$ All eqtns fullfilled $\Rightarrow \boxed{\begin{array}{l} w_0 = -1 \\ \bar{w}_r = [1, 1, 1] \end{array}}$

(3)

b)

noise	
0.01	No
0.1	No
0.2	No
0.5	No
2.0	No

} Because you can NOT draw a straight line separating the 2 classes

c) The accuracy decreased considerably.
Train accuracy dropped around ~0.3 (~50%)
Test accuracy dropped around ~0.4 (=50%)

d) I expect it to be lower because the less samples the less it learnes, the more likely to get class 0 confused with class 1.