☆ Fall 2014 - midterm

1] Short an

1] out of syllabus

2] Likelihood,

$$L(D|\theta) = \prod_{k=1}^{n} \frac{\theta^{y^k} e^{-5\theta}}{y!}$$

Log Likelihood,

$$\text{Log}(L(D|\theta)) = \sum_{k=1}^{n} \left[y^k \ln\theta - 5\theta - \ln y! \right]$$

MLE,

$$\frac{\partial L}{\partial \theta} = 0$$

$$\Rightarrow \sum_{k=1}^{n} \left[\frac{y^k}{\theta} - 5 \right] = 0$$

$$\Rightarrow \boxed{\theta = \frac{\sum_{k=1}^{n} y^k}{5n}}$$

3] True, Gaussian naive bayes with independent class variance assumption is a linear classifier

$$w_0 = \ln\left(\frac{\theta}{1-\theta}\right) - \sum \frac{\mu_{i1}^2 - \mu_{i0}^2}{2\sigma^2}$$

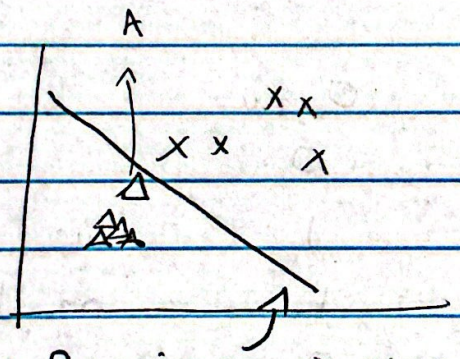
$$w_1 = \frac{\mu_{i1} - \mu_{i0}}{\sigma_i^2}$$

4] not taught yet

2] 1] LR -> No, not possible to draw linear line

3 nearest neighbour -> Yes, it has 0 training error because points of same class are closer in all cases

2]



LR line -> yes

3 nearest - neighbour -> No, point A will misclassify

3] LR -> No, Not possible

KNN -> yes,

3] Refer to Problem 2 Spring 2012 midterm

4] Short Qns.

1] No problem is not linearly seperable
lets say $d = 2$,
It becomes XOR gate, XOR gate is a non linear problem

2] $d = 3$

x_1	x_2	x_3	Output
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

we would need like d n leaves or tree of height d

number of nodes of Tree with height $\underline{d = 2^d - 1}$

3] True, because as data points reach infinity prior will be negligible

MAP $\propto$ MLE $\times$ Prior

if MLE $\to \infty$ & Prior is some constant

Asymptotic analysis say it is same as MLE.

6] Problem 6] NN

1] Yes, because a neural network with ~~one~~ many linear nodes is just a fancy way to write a perceptron.

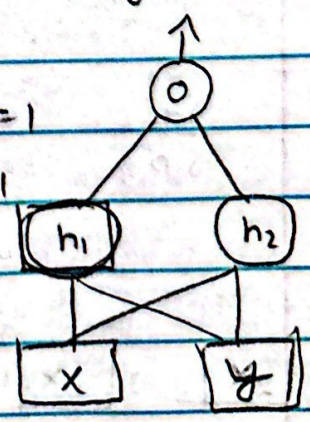
ex:- It might look like

$w_0 + x_1(w_1 + w_2 w_3 + w_4) + x_2(w_4 + w_3 w_2 \ldots)$

which is still linear

2] It is a XOR gate (fancy XOR)

$(x \wedge y) \vee (-x \wedge -y)$



$(x \wedge y) \leftarrow h_1 \Rightarrow w_0 = -1.5, w_1 = 1, w_2 = 1$

$(-x \wedge -y) \leftarrow h_2 \Rightarrow w_0 = 0.5, w_1 = -1, w_2 = -1$

h_1 & h_2 are threshold functions

ie. if ouput > 0 1 else -1

$o \Rightarrow w_0 = 1.5, w_1 = 1, w_2 = 1$

o is threshold function

if $o > 0$ then 10 else -5

3] $o_3 = w_1 x_0 + w_2 x_1 + w_3 x_2$

$o_1 = w_4 o_3$

$o_2 = w_5 o_3$

$o_3 = 3 \times 1 + 2 \times 0 + 2 \times 1$

$o_3 = 5$

$o_1 = 3 \times 5 = 15$

$o_2 = 2 \times 5 = 10$

4] $\text{Loss} = \sum_{i=1}^{2} (y_i - o_i)^2$

$$\frac{1}{2}\frac{\partial L}{\partial o_1} = \underbrace{(y_1 - o_1)(o_1)(1 - o_1)}_{\delta_1} o_3$$

$$\frac{1}{2}\frac{\partial L}{\partial o_2} = \underbrace{(y_2 - o_2)(o_2)(1 - o_2)}_{\delta_2} o_3$$

$$\frac{\partial L}{\partial o_3} = \underbrace{\sum_{i=1}^{2} (y_i - o_i)(o_i)(1 - o_i)\, o_3 (1 - o_3)}_{\delta_3} x_j$$

5] $w_1 = w_1 - \delta_3 x_0 = w_1 - \delta_3$

$w_2 = w_2 - \delta_3 x_1$

$w_3 = w_3 - \delta_3 x_2$

$w_4 = w_4 - \delta_1 o_3$

$w_5 = w_5 - \delta_2 o_3$