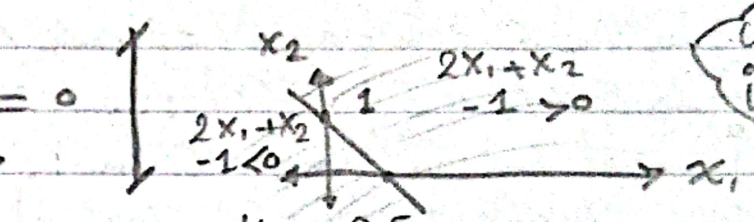
Sheet 2

Q:1 $w = (1, 0.5)^T$, $w_0 = -0.5$ → $\begin{pmatrix}1\\0.5\end{pmatrix}(x_1\ x_2) - 0.5 = 0$

∴ $x_1 + 0.5x_2 - 0.5 = 0$

& $2x_1 + x_2 - 1 = 0$

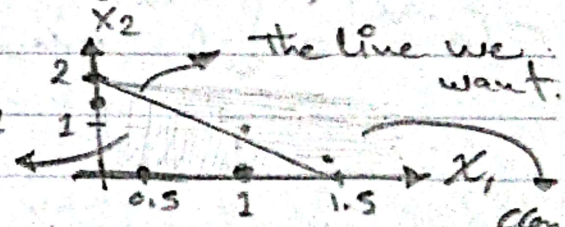


where x_n is Feature no n.

x_1		x_2	
0	→	1	→ $P_1 = (0,1)$
0.5	←	0	→ $P_2 = (0.5, 0)$

Q:2 → Class1 → Point1: (0, 1.5), Point2: (1, 0), Point3: (0.5, 0)

→ Class2 → Point1: (1, 1), Point2: (1.5, 0.5)



the Line →

$w_1x_1 + w_2x_2 + w_0 = 0$

$m = \frac{y_1 - y_0}{x_1 - x_0} = \frac{2-0}{0-1.5} = -4/3$ → $y = mx + C$

$C = 2$

$y = -\frac{4}{3}x + 2$

$x_2 = -\frac{4}{3}x_1 + 2$ → $\frac{4}{3}x_1 + x_2 - 2 = 0$

Class1 < 0 , Class2 > 0

Given Point6: (1, 1.5)

$4x_1 + 3x_2 - 6 = 0$

$4(1) + 3(1.5) - 6 =$

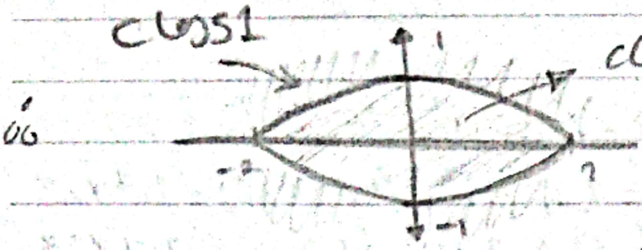
$4 + 4.5 - 6 = 1.5 > 0$ & Class2 ✓

* رسمت الـ line بالنظر بعدين جبت المعادلة بالكتاب!

Recall: Ellipse Eq

$$\left(\frac{x-x_0}{a}\right)^2+\left(\frac{y-y_0}{b}\right)^2=1$$

Q:3 Eq → $\frac{x_1^2}{4}+x_2^2=1$

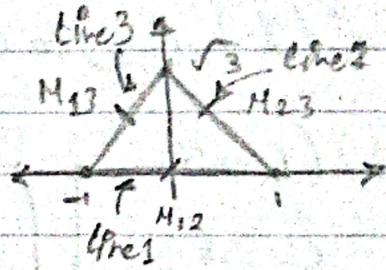


for class 1 → $\frac{x_1^2}{4}+\frac{x_2^2}{1}-1>0$

for class 2 → $\frac{x_1^2}{4}+\frac{x_2^2}{1}-1<0$

Q:4 $C_1=(-1,0)$, $C_2=(1,0)$, $C_3=(0,\sqrt{3})$

* Calc mid-points → $M_{12}=(0,0)$
  → $M_{23}=(-1/2,\sqrt{3}/2)$
  → $M_{13}=(1/2,\sqrt{3}/2)$



* Get the normal on every line passing through its midpoint → $m)_{line2}=\frac{\sqrt{3}-0}{0-1}=-\sqrt{3}$, $m)_{N2}=\frac{-1}{m)_{line2}}$

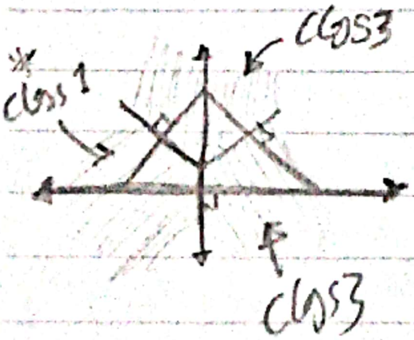
$m)_{N2}=\frac{1}{\sqrt{3}}$, subst in $y=m)_{N2}x+c$ with m_{23} → Get $c=1/\sqrt{3}$

So Normal$)_2$ ⇒ $y=1/\sqrt{3}\,x+1/\sqrt{3}$

Normal$)_3$ ⇒ $y=-1/\sqrt{3}\,x+1/\sqrt{3}$ ← عشان هو العكس بناءً

Normal$)_1$ ⇒ $x=0$

- خد بالك كمان ممكن نجيبها كطريقة (m_{23} و P_1) عشان هو iso-triangle !



* we call this Normal lines → Decision Boundaries (DB)

NN → Calc All [d], classify according to the min [d]

KNN → Calc All [d], ——— Nearest K [d]

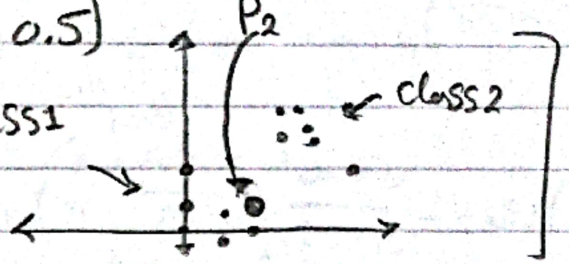
Q:6

class1	class2
Point1 → (1.2, 1.2)	
$d^2 = (1.2-0)^2 + (1.2-0)^2 = 2.88$	$d^2 = (1.2-2)^2 + (1.2-2)^2 = \boxed{1.28}$
$d^2 = (1.2-0.5)^2 + (1.2+0.1)^2 = 2.18$	$d^2 = (1.2-2)^2 + (1.2-2.25)^2 = \boxed{1.7425}$
$d^2 = (1.2-0.5)^2 + (1.2-0.25)^2 = \boxed{1.3325}$	$d^2 = (1.2-2.25)^2 + (1.2-2)^2 = \boxed{1.7425}$
$d^2 = (1.2-1)^2 + (1.2-0)^2 = \boxed{1.48}$	$d^2 = (1.2-2.25)^2 + (1.2-2.25)^2 = 2.2$
$d^2 = (1.2-0)^2 + (1.2-0.5)^2 = \boxed{1.93}$	$d^2 = (1.2-2.1)^2 + (1.2-2.5)^2 = 2.5$
$d^2 = (1.2-0)^2 + (1.2-1)^2 = 1.48$	$d^2 = (1.2-3.5)^2 + (1.2-1.5)^2 = 5.58$

So Point1 belongs to class → class 2 using NN → $d = \sqrt{1.28}$

↳ class 1 using KNN with K=3

Point2 (1, 0.5)



So visually, P2 will always belong to class 1

Q:5 حل زی سوال ✱