

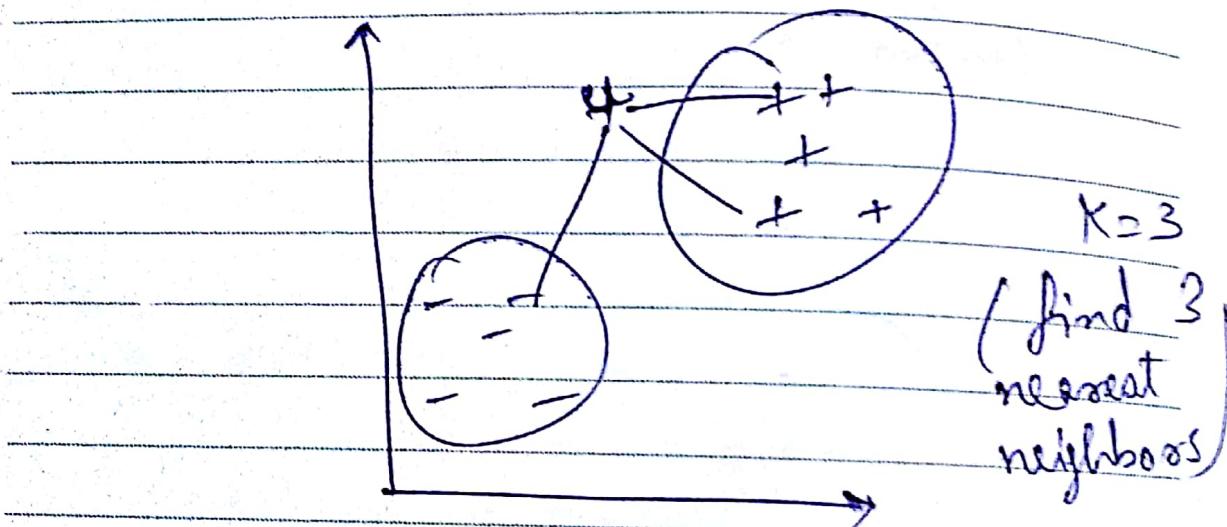
28 Friday
JANUARY

JANUARY							2011
S	M	T	W	T	F	S	
1	2	3	4	5	6	7	
8	9	10	11	12	13	14	
15	16	17	18	19	20	21	
22	23	24	25	26	27	28	
29	30	31					

KNN

find euclidean dist
between new features & existing
ones.

The nearest neighbor's cluster is
the ~~#~~ cluster of the new feature.



Since the nearest neighbors
are +, +, -, ?

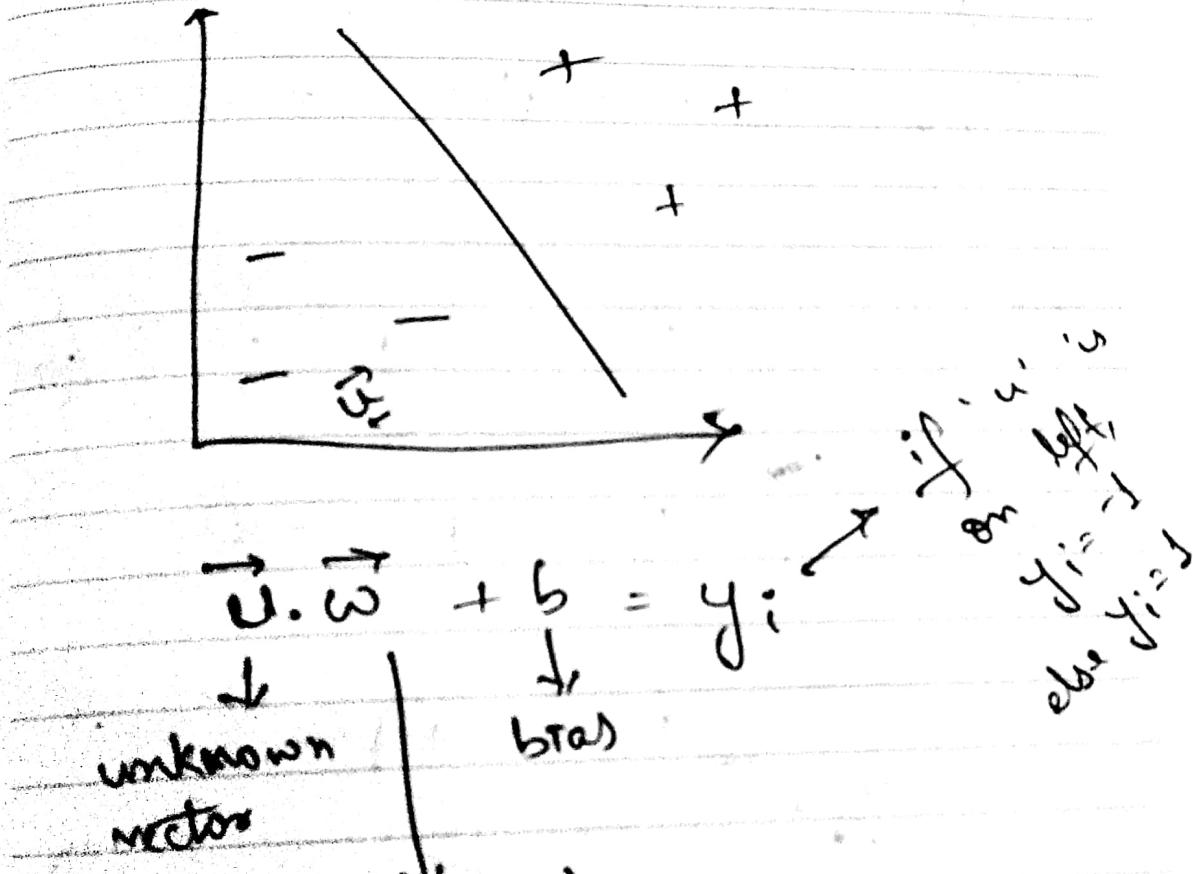
∴ the new feature belongs
to + cluster.

2011
F S
2 1
14 8
21 15
28 22
29

FEBRUARY 2011					
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6	7	15	16	17	18
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20	21	28		25	26

Saturday 29
JANUARY

SVM (support vector machine)



vector that
points to
the hyperplane

Sunday 30

2011

31 Monday
JANUARY

JANUARY						
S	M	T	W	T	F	S
30	31					2011
2	3	4	5	6	7	1
9	10	11	12	13	14	8
16	17	18	19	20	21	15
23	24	25	26	27	28	22
						29

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13	14	15	16	17		
20	21	22	23	24		
27	28					

$$\vec{x} - s_v \downarrow r$$

$$\vec{x}_{+sv} \rightarrow -u \text{ plus}$$

$$\vec{x} - s_v \cdot \vec{w} + b = -1 \rightarrow 0$$

$$\vec{x}_{+sv} \cdot \vec{w} + b = 1 \rightarrow 0$$

$$+ = + \text{ and } - = -$$

(class) $\begin{cases} + \\ - \end{cases}$ $\begin{cases} + \\ - \end{cases}$ (3)

If y_i is '+' class $\rightarrow y_i = +$

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Tuesday 1
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+ class $\rightarrow \vec{x}_i \cdot \vec{w} + b = 1 \rightarrow (4)$
 $y_i = 1$

- class $\rightarrow \vec{x}_i \cdot \vec{w} + b = -1 \rightarrow (5)$
 $y_i = -1$

multiply (4) & (5) by y_i

$\Rightarrow y_i (\vec{x}_i \cdot \vec{w} + b) = (1) y_i$

$y_i (\vec{x}_i \cdot \vec{w} + b) = (-1) y_i$

$\Rightarrow y_i (\vec{x}_i \cdot \vec{w} + b) = 1 \cdot 1 \quad (\because y_i = 1)$

$y_i (\vec{x}_i \cdot \vec{w} + b) = (-1) (-1) \quad (\because y_i = -1)$

$\Rightarrow (4) \& (5)$ becomes (taking RHS to LHS)

$y_i (\vec{x}_i \cdot \vec{w} + b) - 1 = 0$

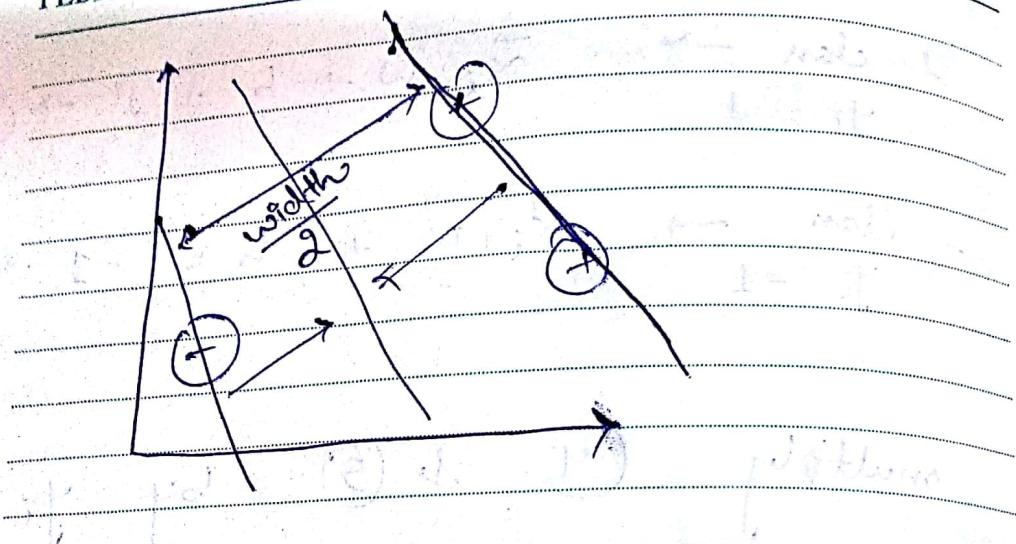
$y_i (\vec{x}_i \cdot \vec{w} + b) - 1 = 0 \rightarrow @$

2011

2 Wednesday
FEBRUARY

FEBRUARY						
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27	28					

MARCH						
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27	28					



$$\text{width} = \frac{(\vec{x}_+ - \vec{x}_-)^T \vec{w}}{\|\vec{w}\|} \rightarrow (1)$$

maximum 2L

$$\therefore \vec{x}_+ = \vec{x}_- + y_i (\vec{x}_i^T \vec{w} + b) - L \rightarrow (1)$$

putting (1) in (1)

$$\text{for } y_i = +1 \text{ or } \vec{x}_i^T \vec{w} = 1 - b \\ \text{(taking } -1 \text{ & } b \text{ to RHS)}$$

$$\text{for } y_i = -1 \text{ or } \vec{x}_i^T \vec{w} = -(1 - b) \text{ (taking } +1 \text{ & } -b \text{ to RHS)} \\ = -(1 - b)$$

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Thursday 3
FEBRUARY

$$\text{or width} = \left| y_i (\vec{x}_i \cdot \vec{w} + b) - 1 \right|$$

$$\text{or width} = \sqrt{\left[y_i (\vec{x}_i \cdot \vec{w} + b) - 1 \right]^2 + \left[y_i (\vec{x}_i \cdot \vec{w} + b) - 1 \right]^2}$$

$$\text{width} = \sqrt{\left[1 (\vec{x}_i \cdot \vec{w} + b) - 1 \right]^2 + \left[-1 (\vec{x}_i \cdot \vec{w}) + b - 1 \right]^2}$$

$$\text{width} = \sqrt{\vec{x}_i \cdot \vec{w} + b - 1 - \sqrt{-\vec{x}_i \cdot \vec{w} + b - 1}}.$$

$$\text{width} = \frac{\vec{x}_+ \cdot \vec{w} - \vec{x}_- \cdot \vec{w}}{\|\vec{w}\|}$$

$$= 1 - b - (-1 - b)$$

2011

4 Friday
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MARCH 2011						
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$$\text{for } y_i = 1 \quad \vec{x}_+ \cdot \vec{w} = y_i(1-b) \quad \left. \begin{array}{l} \text{(from } j_i = 1\text{)} \\ (3) \end{array} \right\}$$

$$\text{for } y_i = -1 \quad \vec{x}_- \cdot \vec{w} = y_i(b - (1-b))$$

~~put (3) in (2)~~

expanding (1)

$$\frac{\vec{x}_+ \cdot \vec{w} - \vec{x}_- \cdot \vec{w}}{\|\vec{w}\|} = \text{width} \rightarrow (4)$$

or put (3) in (4)

$$\frac{1-b - [-(1+b)]}{\|\vec{w}\|} \rightarrow \text{width}$$

$$\text{width} = \frac{1-b + 1+b}{\|\vec{w}\|}$$

width =

width

max

or

or m

$$\max \frac{1}{\|\vec{w}\|}$$

min width

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Saturday 5
FEBRUARY

$$\text{width} = \frac{1 - b + (1 + b)}{\|w\|}$$

~~$1 - b$~~

$$= \frac{1 - b}{\|w\|} + (1 + b) \left(\because -\vec{x} \cdot \vec{w} = 1 \right)$$

from eq (a)

$$\boxed{\text{width} = \frac{2}{\|w\|}}$$

$\therefore y_i = -1$

maximise width

$$\Rightarrow \text{maximize} \rightarrow \frac{1}{\|w\|} \quad (\text{dropping constant}(2))$$

$$\Rightarrow \text{minimize} \quad \|w\|$$

Sunday 6

$$\max \frac{1}{\|w\|} \rightarrow \min \|w\| \rightarrow \boxed{\min \frac{1}{2} \|w\|^2}$$

for minimizing $\frac{1}{2} \|w\|^2$ } mathematically convenient

with maximize $\frac{1}{\|w\|}$

2011

7 Monday
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$$L(\omega, b) = \frac{1}{2} \|\bar{\omega}\|^2 - \sum \alpha_i [y_i (\bar{\omega} \cdot \bar{x}_i + b) - 1]$$

↑ minimize ↑ maximize

L (b)

differentiating L w.r.t to all variables

$$\frac{\partial L}{\partial \omega} = \bar{\omega} - \sum \alpha_i y_i \bar{x}_i = 0$$

$$\boxed{\Rightarrow \bar{\omega} = \sum \alpha_i y_i \bar{x}_i} \rightarrow (c)$$

$$\frac{\partial L}{\partial b} = - \sum \alpha_i y_i = 0$$

$$\boxed{\Rightarrow \sum \alpha_i y_i = 0} \rightarrow (d)$$

put (c) in (b)

2011

(P.T.O)

Tuesday 8
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We're finding what this maximization depends on these sample vectors.

$$L = \frac{1}{2} \left[\left(\sum d_i y_i x_i \right) \left(\sum d_j y_j x_j \right) \right] -$$

$$\sum d_i y_i x_i \left[\sum d_j y_j x_j \right] - \underbrace{\sum d_i y_i b}_{\Rightarrow 0 \text{ (bound)}} + \sum d_i$$

$$L = \sum d_i - \frac{1}{2} \sum \sum d_i d_j y_i y_j x_i x_j$$

↓

maximum

↓

optimization depends only on $\langle \cdot, \cdot \rangle$
product of pairs of samples

$$\text{e.g., } (x_i \cdot x_j)$$

2011

9 Wednesday

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$$\sum_i d_i y_i \underline{\vec{x}_i \cdot \vec{v}} + b > 0 \text{ then the}$$

dependent
on dot product
of 2 vectors

→ But for samples that are not linearly separable,
then we need a transformation
that will take us from
the space we're in to the
space where things are more
convenient.
We'll that transformation $\rightarrow \phi(\vec{x})$

$$\phi(\vec{x}) \rightarrow \phi(\vec{y}) \rightarrow \text{softmax}$$

2011

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Thursday 10
FEBRUARY

$$\phi(x_i) \cdot \phi(x_j) \rightarrow \text{MAX}$$

$$\phi(x_i) \cdot \phi(u)$$

$$k(x_i, x_j) = \phi(x_i) \cdot \phi(x_j)$$

↓
kernel function

Some of the popular kernels

① Linear kernels

$$(\vec{u} \cdot \vec{v} + b)^n$$

② $e^{-\frac{\|x_i - x_j\|}{\sigma}}$ Radial Basis Kernel
exponential

2011