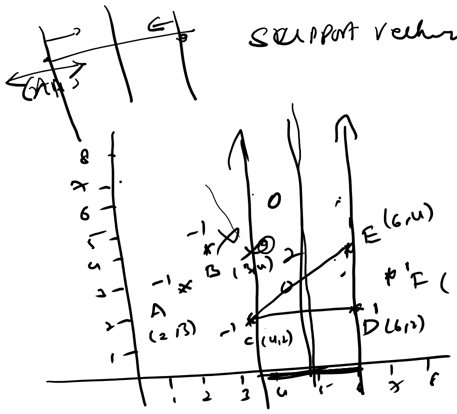
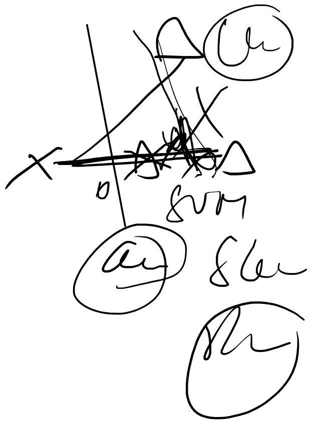
Support vector



x	y
[2,3]	-1
[3,4]	-1
[4,2]	-1
[6,2]	+1
[6,4]	+1
[7,3]	+1



A B C D E F
(2,3) (3,4) (4,2) (6,2) (6,4) (7,3)

A → D = $\sqrt{(2-3)^2+(6-2)^2} = \sqrt{1+4^2} = \sqrt{17} = 4.12$

A → E = $\sqrt{(4-3)^2+(6-2)^2} = \sqrt{1+4^2} = \sqrt{17} = 4.12$

A → F = $\sqrt{(3-3)^2+(7-2)^2} = \sqrt{0+5^2} = \sqrt{5^2} = 5$

B → D = $\sqrt{(2-4)^2+(6-3)^2} = \sqrt{2^2+3^2} = \sqrt{4+9} = \sqrt{13} = 3.6$

B → E = $\sqrt{(4-4)^2+(6-3)^2} = \sqrt{0+3^2} = \sqrt{3^2} = 3$

B → F = $\sqrt{(3-4)^2+(7-3)^2} = \sqrt{1+4^2} = \sqrt{1+16} = 4.12$

C → D = $\sqrt{(2-2)^2+(6-4)^2} = \sqrt{2^2} = 2$ C (4,2) D (6,2) E (6,4) F (7,3)

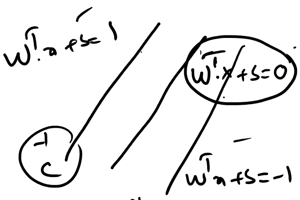
C → E = $\sqrt{(4-2)^2+(6-4)^2} = \sqrt{2^2+2^2} = \sqrt{8} = 2.8$

C → F = $\sqrt{(7-2)^2+(7-4)^2} = \sqrt{1^2+3^2} = \sqrt{1+9} = \sqrt{10} = 3.162$

C	D	E	x	y
(4,2)	(6,2)	(6,4)	[4,2]	-1
-1	+1	+1		

$w^T.x + b = \pm 1$ $w^T.x+b=1$

C(4,2) $w^T x + b = -1$



$4w_1 + 2w_2 + b = -1$ —— ①

D (6,2) y = 1

$6w_1 + 2w_2 + b = 1$ —— ②

E (6,4) y = 1

$6w_1 + 4w_2 + b = 1$ —— ③

① & ②

$4w_1 + 2w_2 + b = -1$
$-\ 6w_1 + 2w_2 + b = 1$
$-2w_1 = -2$
$w_1 = 1$

$4 + 2w_2 + b = -1$
$6 + 4w_2 + b = 1$

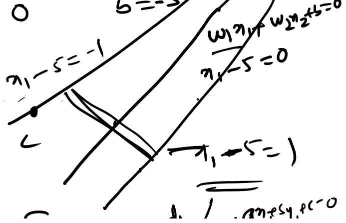
$2w_2 + b = -1 - 4$ $2w_2 + b = -5$
$4w_2 + b = 1 - 6$ $4w_2 + b = -5$
$-2w_2 = 0$
$w_2 = 0$

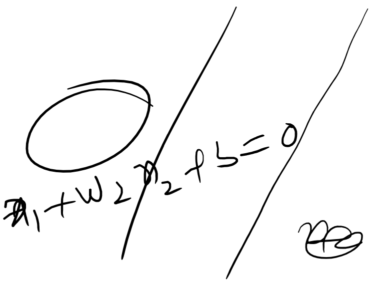
$4w_2 + b = -5$
$b = -5$

$w_1 = 1$ $w_2 = 0$ $b = -5$

$w_1 x_1 + w_2 x_2 + b = -1$

$w_1 x_1 + w_2 x_2 + b = 1$





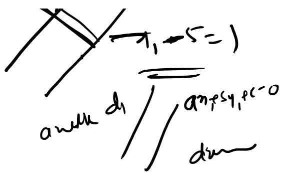
$w_1 x_1 + w_2 x_2 + b = -1$

$w_1 x_1 + w_2 x_2 + b = 1$

$\begin{bmatrix} w_1 \\ w_2 \end{bmatrix} (x_1\ x_2) + b$

$w_1 x_1 + \ldots x_n + b$

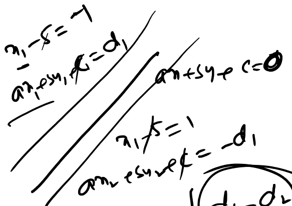
$w_1 x_1 + w_2 x_2 + b = 1$



$\|w\| = \sqrt{1^2 + 0^2} = \sqrt{1}$

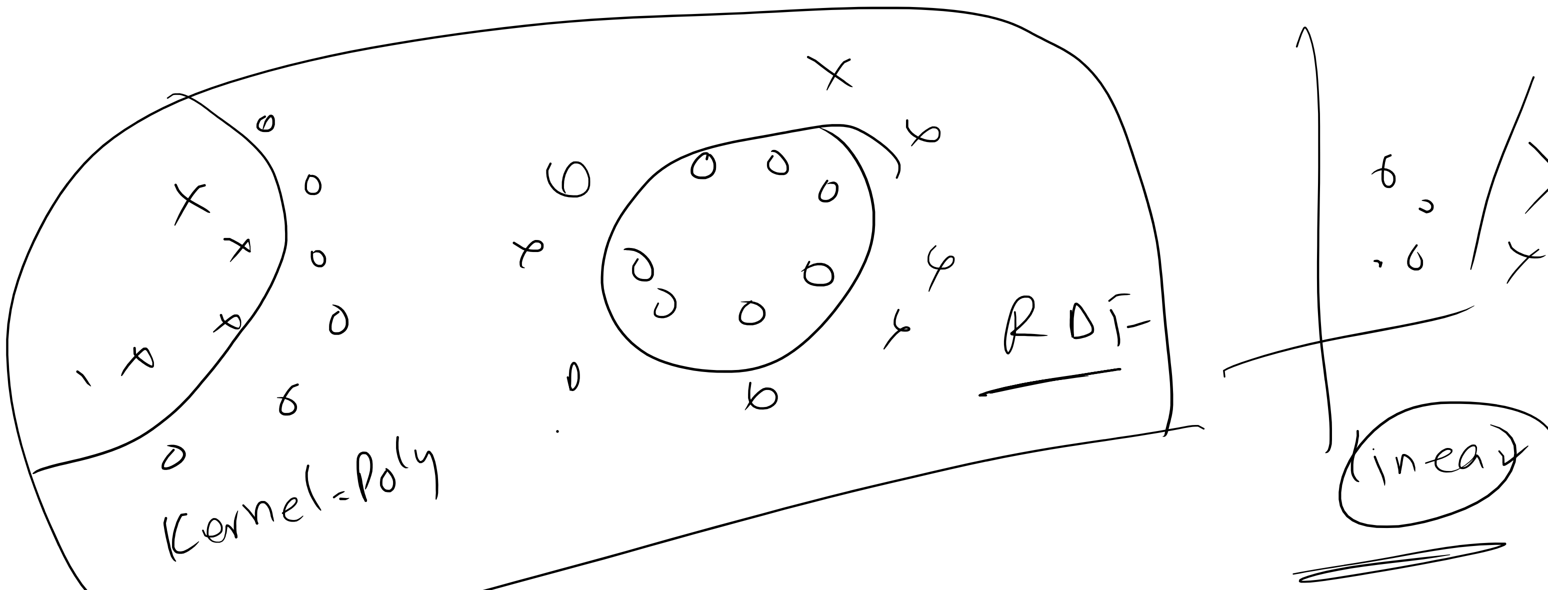
$d_{\text{max}} = \frac{2}{\|w\|} = \frac{2}{1}$

$\frac{|d_1 - d_2|}{\sqrt{a^2 + s^2}} \quad \frac{2}{\sqrt{1^2+0}} = 2$



$\frac{|d_1 - d_2|}{\sqrt{a^2 + s^2}} \quad \frac{2}{\sqrt{1^2 + 0}}$

$= \frac{2}{1} = 2$



Optimization svm

$$\min\left(\frac{1}{2}\|w\|^2 + C\left(\Sigma e_i\right)\right)$$

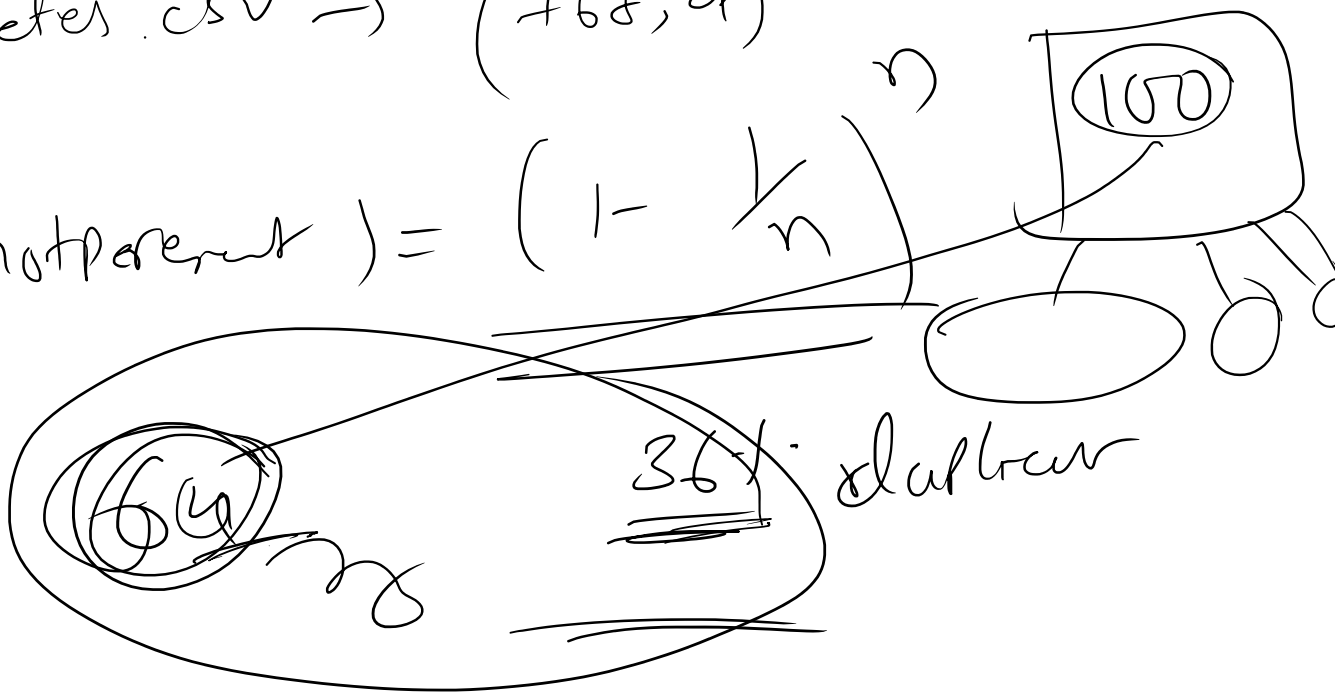
x	class y
	0

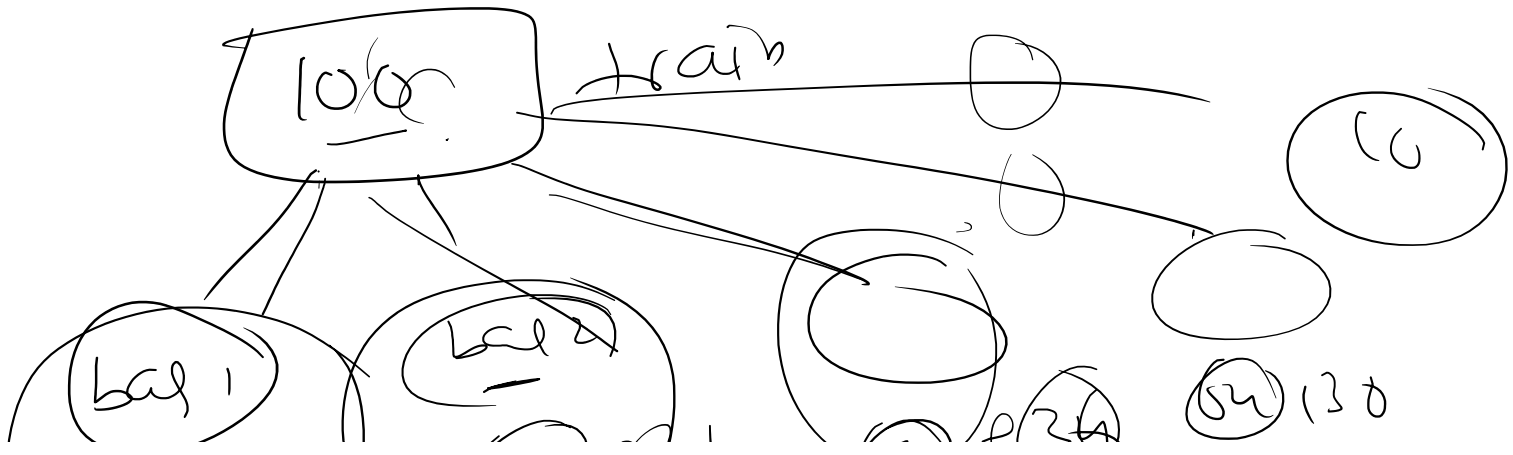
	x	class
0	2	0
1	4	0
2	5	1
3	7	1

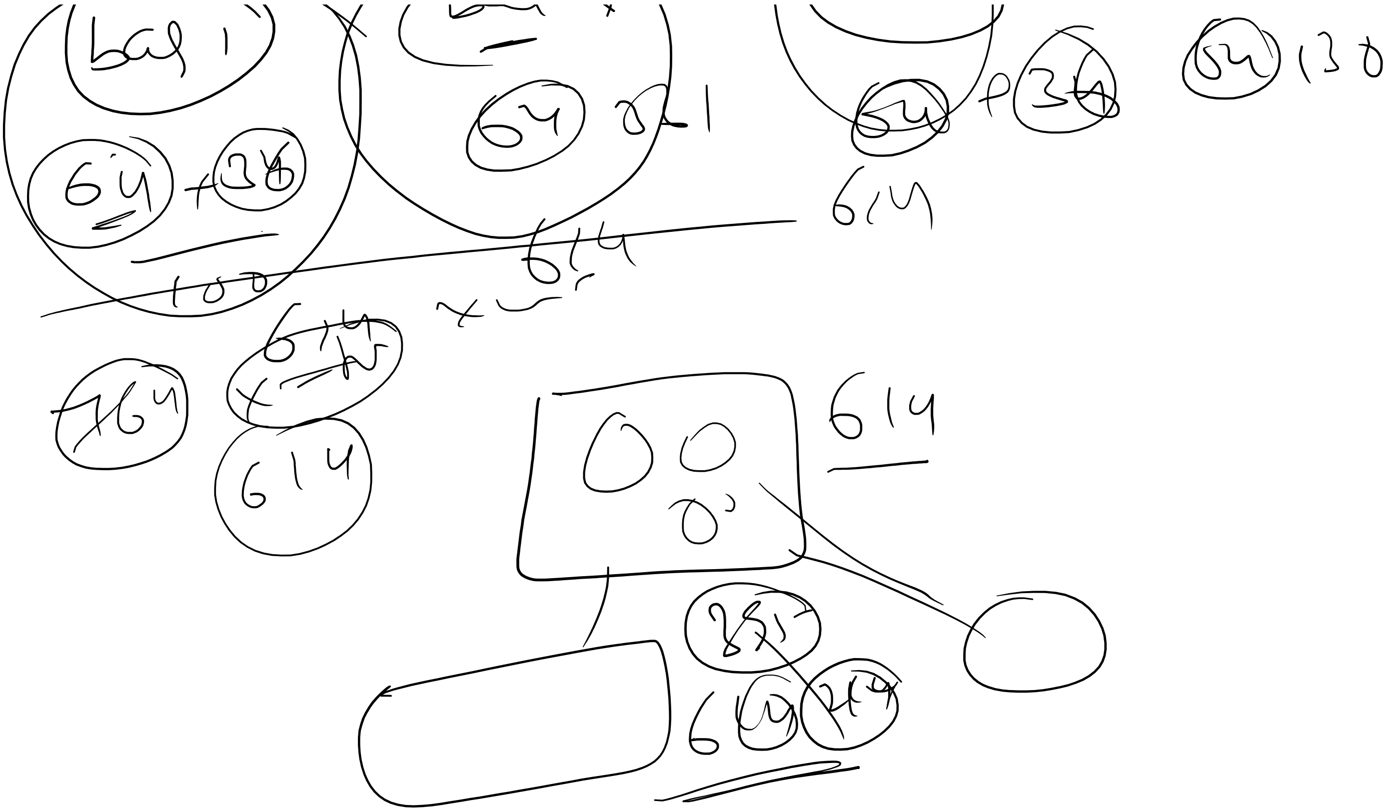
D1: 2, 4 | 2, 5

diabetes.csv → (768, 9)

$$p(\text{notparent}) = \left(1 - \frac{1}{n}\right)^n$$





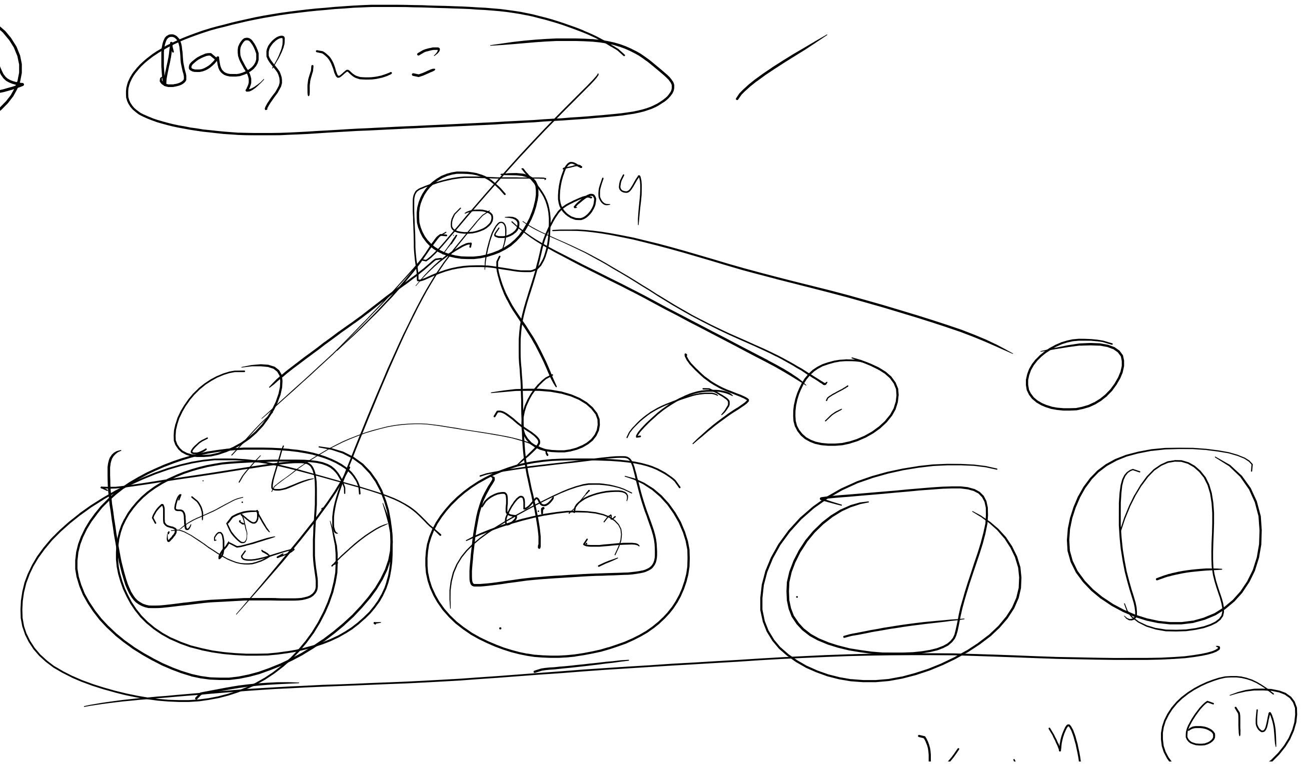


① Bagging is reduce variance in models

② Model will become complex

small fluctuation overfit

③ Bagging =



614

$p(\text{not selected}) = \left(1 - \frac{1}{n}\right)^n$

764

36.1

63.2

614

Ranks

Bagging classifier

Ensemble

Random Forest — DT

BC, A, B — DT, C

A, B, C

SVC RF

LR DT

1 1

0 0 1 hard

0.6 0.7

1.3

0.5 0.6

1.1

Soft

. Bootstrap samples

(Data)