X_1 X_2 y
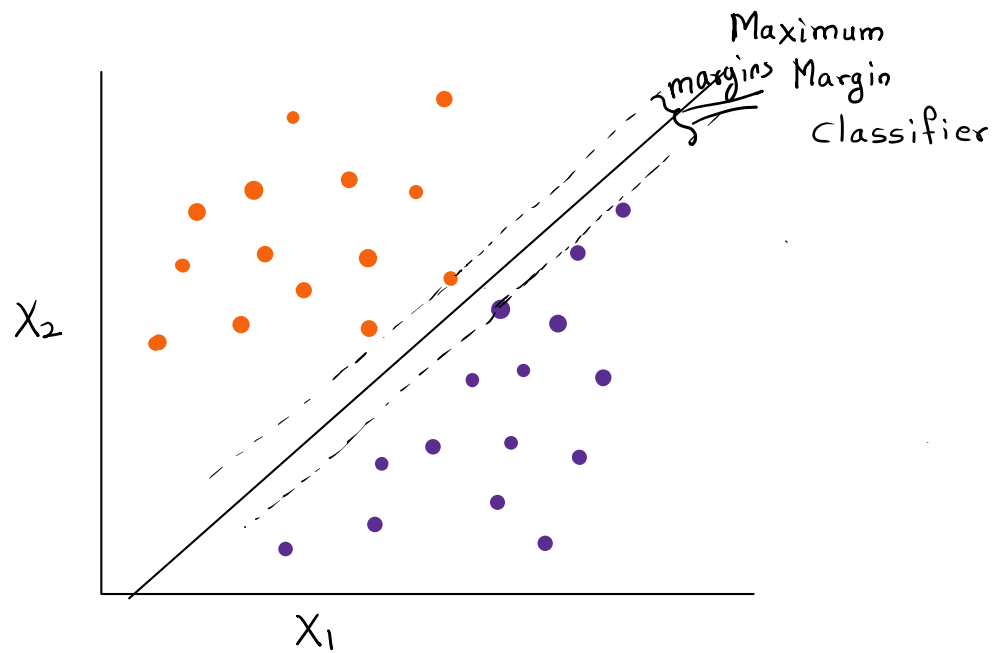
1   Orange $\equiv 1$
1   Blue $\equiv 0$
0
0
0
1
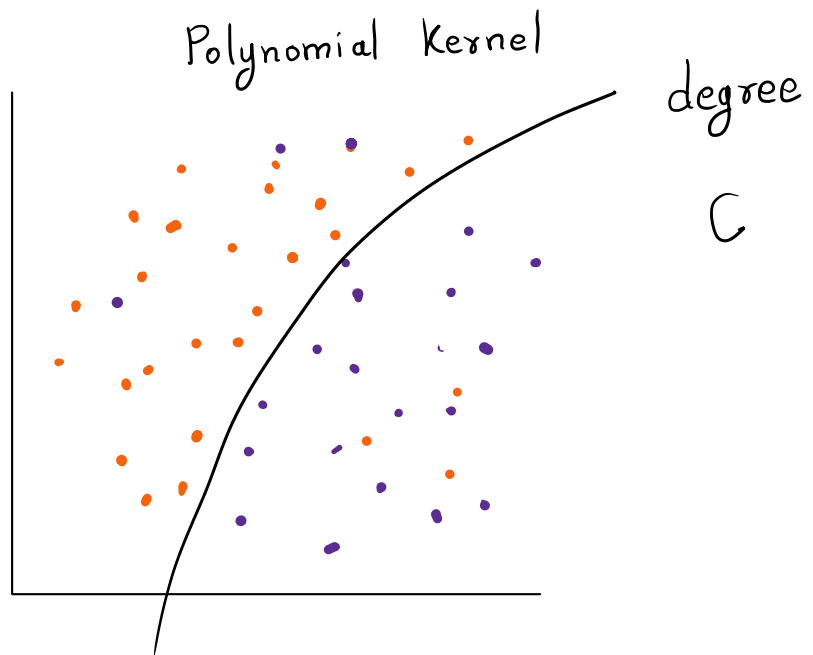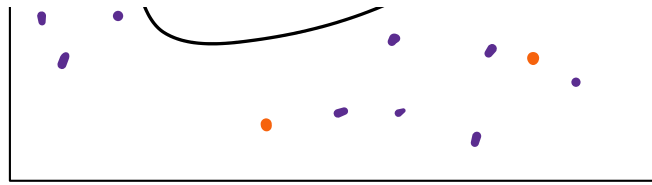0

Maximum Margin Classifier

margins

X_2

X_1

(Lagrange's multipliers)

Testing

⊙ A
⊙ B Blue
⊙ C
⊙ D Orange

Linear   SVM classifier

Training

Blue

X_2

⊙A

⊙C

⊙B

⊙D

Orange X_1

$C \propto \dfrac{1}{margin}$

Radial Kernel

gamma

C

Polynomial Kernel

degree

C
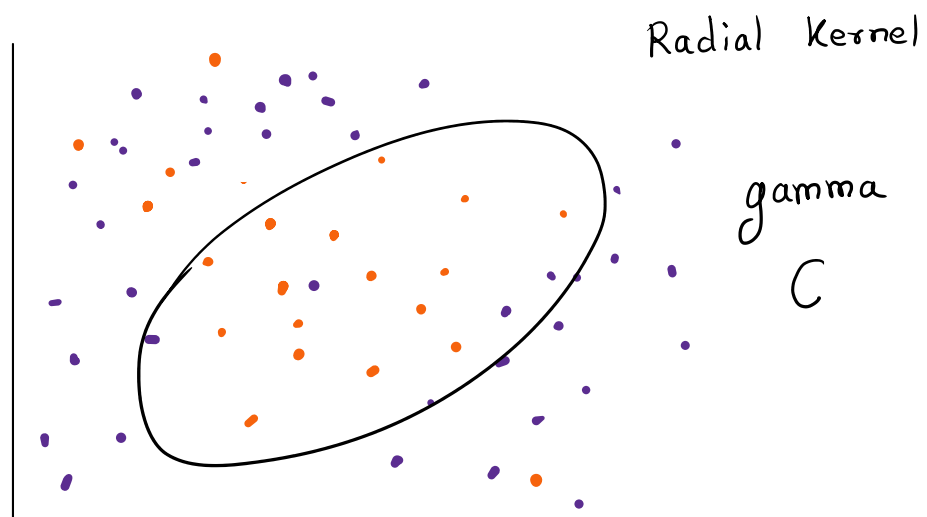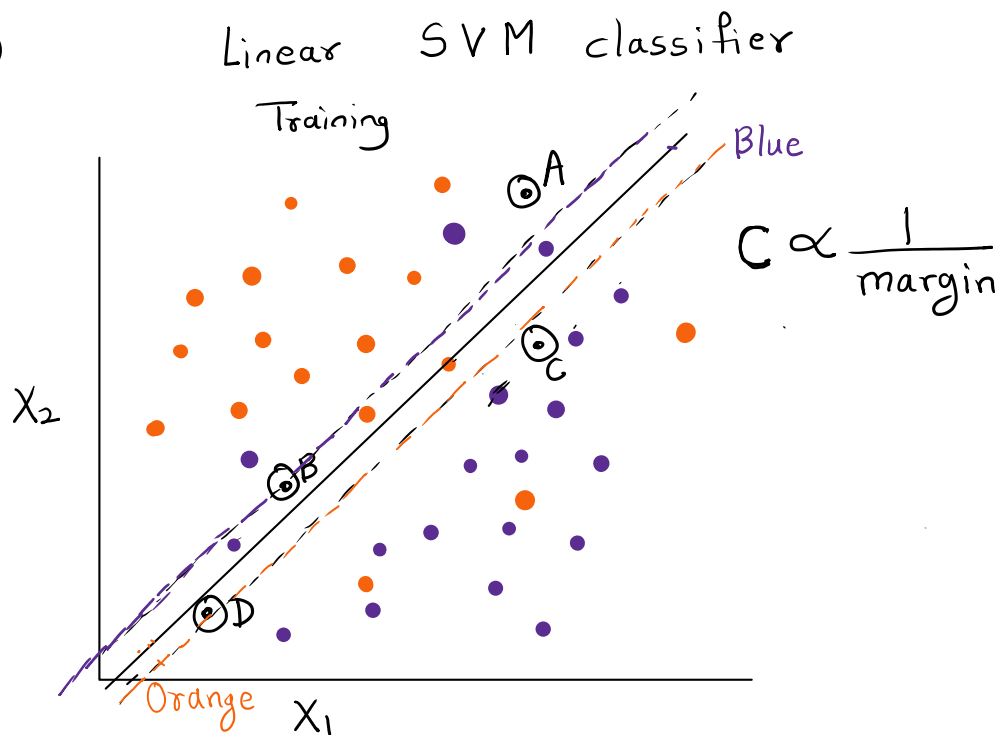
Support Vector Machines

One Vs One

Train

$y \quad X_1 \ldots X_K$

$\left.\begin{array}{l} A \\ A \\ \vdots \\ A \end{array}\right\} 30$

$\left.\begin{array}{l} B \\ B \\ \vdots \\ B \end{array}\right\} 40$

$\left.\begin{array}{l} C \\ C \\ \vdots \\ C \end{array}\right\} 50$

$\left.\begin{array}{l} A \left.\right\} 30 \\ B \left.\right\} 40 \end{array}\right\} \begin{array}{l} 70 \\ obs \end{array}$

SVM_{AB} → ∘ predict( )

$\left.\begin{array}{l} A \\ C \end{array}\right\} \begin{array}{l} 80 \\ obs \end{array}$

SVM_{AC} → ∘ predict( )

$\left.\begin{array}{l} B \\ C \end{array}\right\} \begin{array}{l} 90 \\ obs \end{array}$

SVM_{BC} → ∘ predict( )

Test

$X_1 \; X_2 \ldots X_P$	$\hat{y}_{AB}$	$\hat{y}_{AC}$	$\hat{y}_{BC}$	$\hat{y}_{final}$
	A	A	B	A
	B	C	C	C
	A	C	B	A

c)

	B	C	C	C
	A	C	B	A

OVR : One Vs Rest of all

Train

$y \quad X_1 \cdots X_k$

$\left.\begin{array}{c} A \\ A \\ \vdots \\ A \end{array}\right\} 30$

$\left.\begin{array}{c} B \\ B \\ \vdots \\ B \end{array}\right\} 40$

$\left.\begin{array}{c} C \\ C \\ \vdots \\ C \end{array}\right\} 50$

y
A : 30
non-A : 90

SVM$_A$

y
B : 40
non-B : 80

SVM$_B$

y
C : 50
non-C : 70

SVM$_C$

• predict_proba()

Test

$X_1 \quad X_2 \cdots X_p$	P(A)	P(B)	P(C)	y_pred
	0.8	0.75	0.5	A