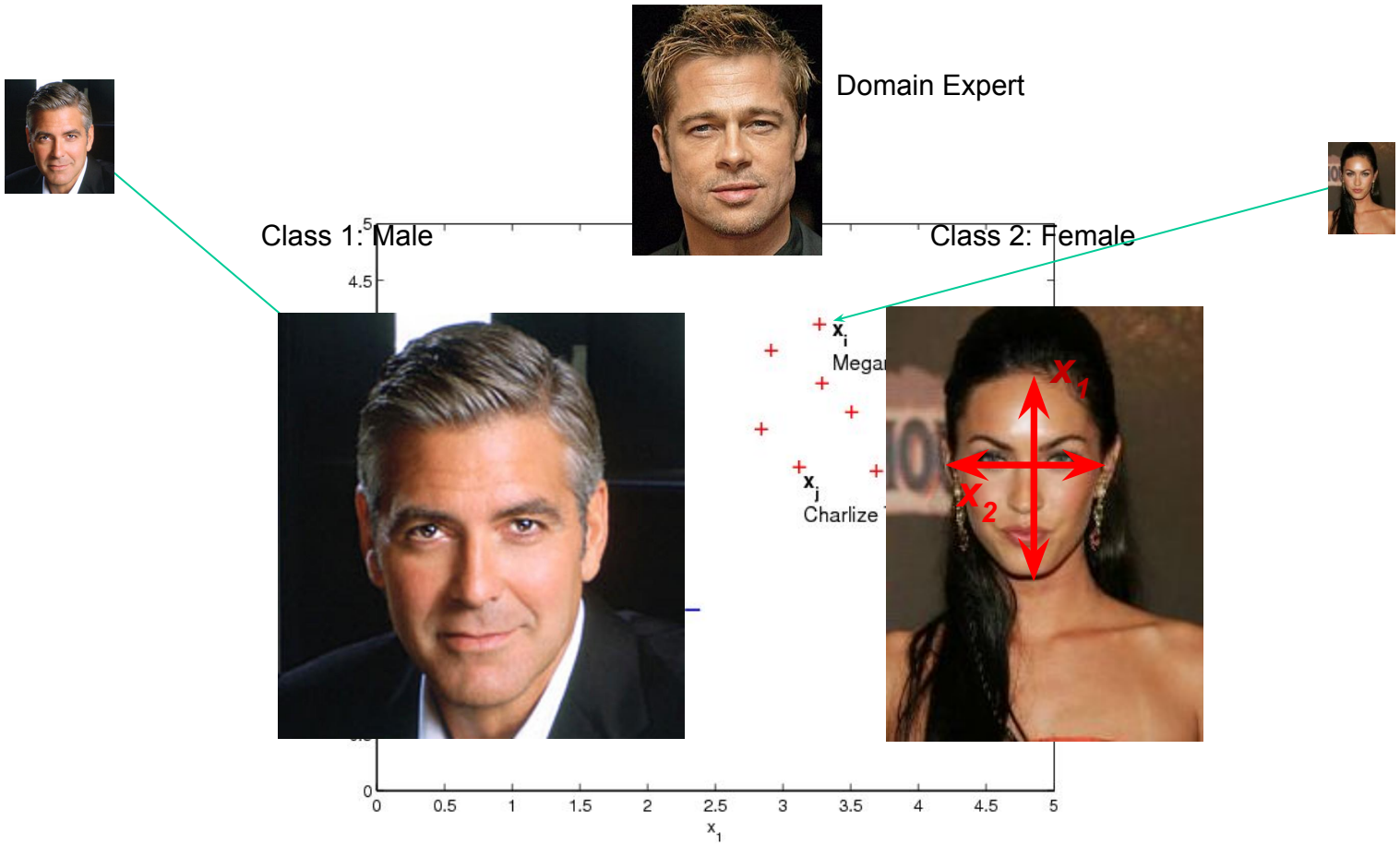
Support Vector Machine

MGTF 495

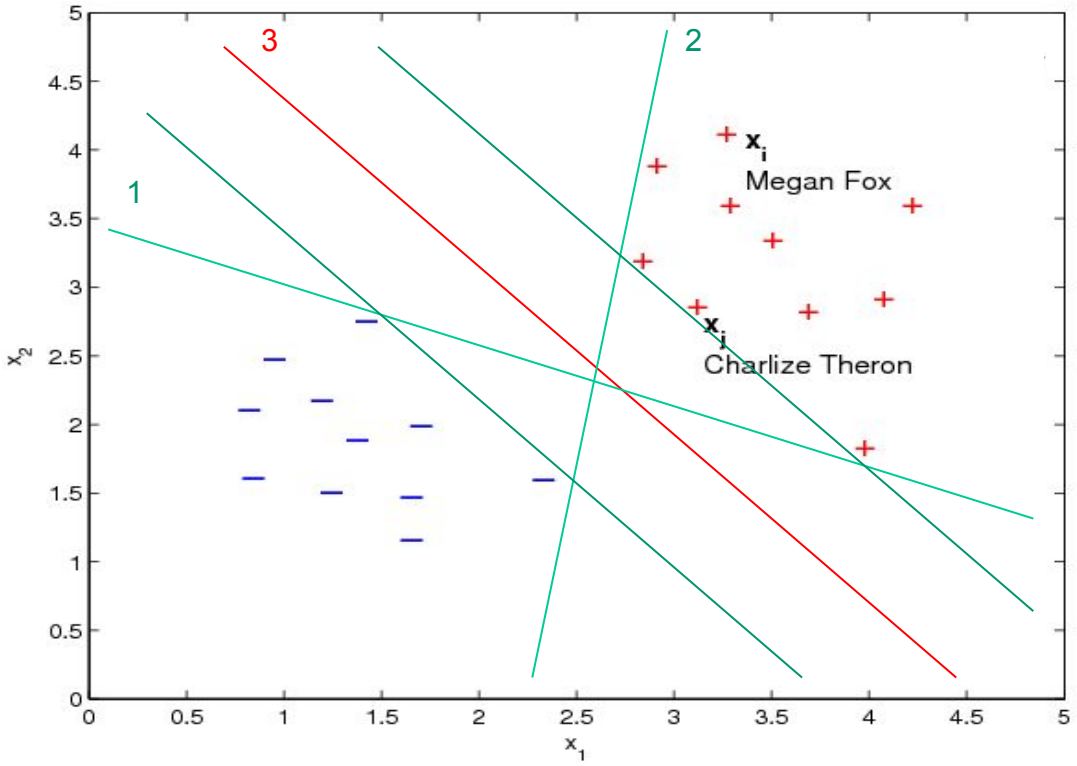
Class Outline

- Generative vs Discriminative Models
- Discriminative Models
  - Logistic Regression
  - SVM
  - Perceptron
- Kernels
- Richer Output Spaces

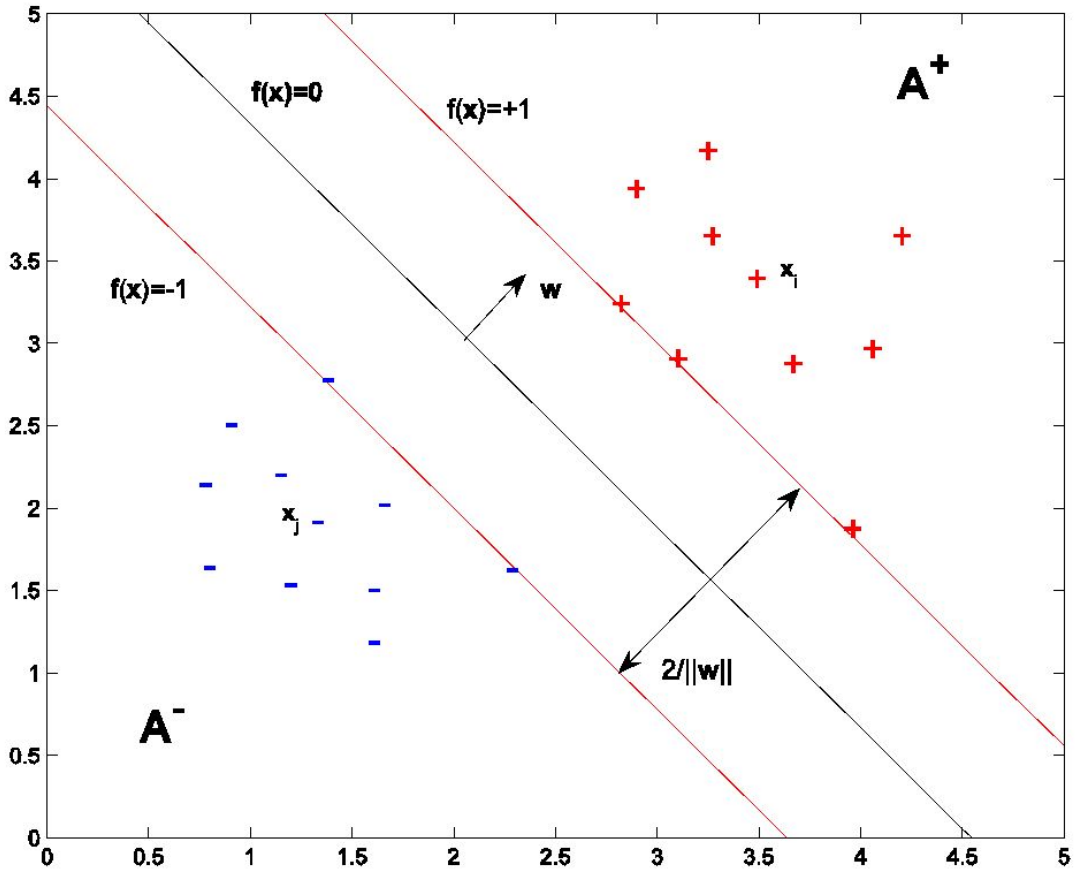
Standard Support Vector Machines



Standard Support Vector Machines



Standard Support Vector Machines



Standard Support Vector Machines

Objective function:

$$\min_{(\mathbf{w}\gamma)} \quad \|\mathbf{w}\|_2^2$$

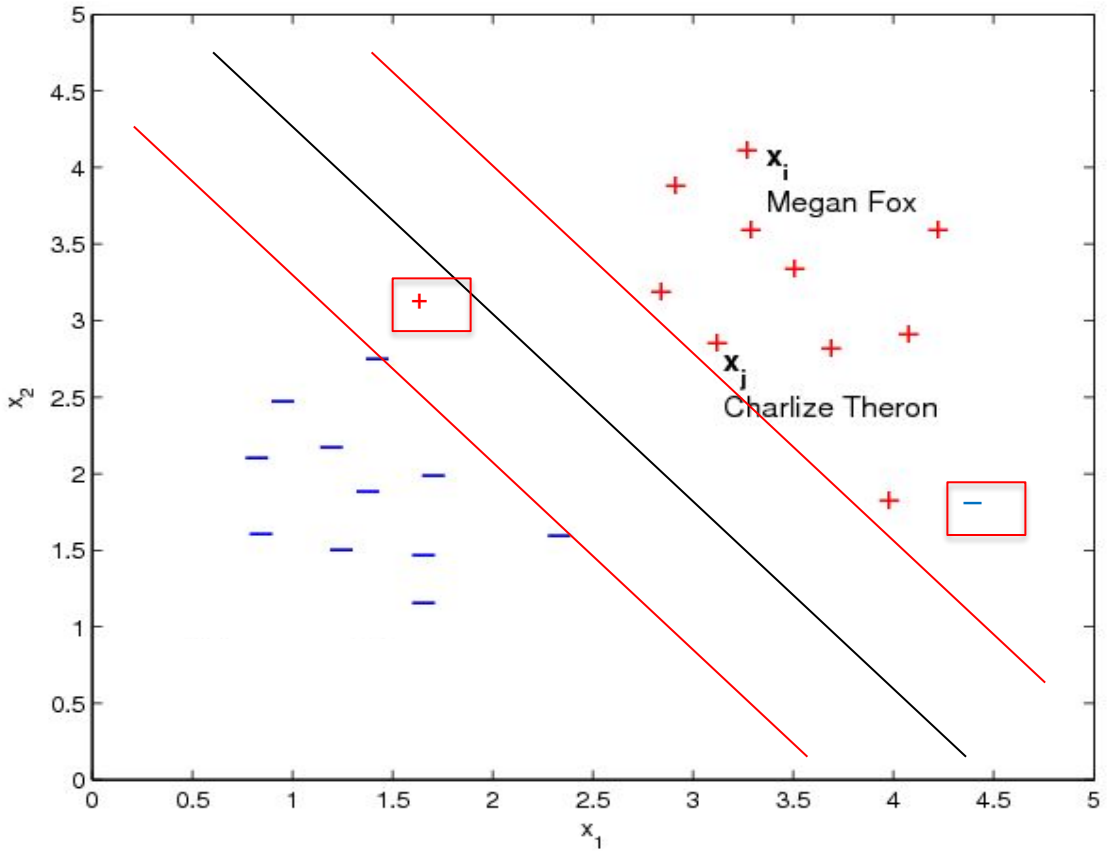
Bounding planes:

$$f(\mathrm{x_i}) \begin{cases} \geq +1 & ,\forall \mathrm{x_i} \in \mathrm{A}^+ \\ \leq -1 & ,\forall \mathrm{x_i} \in \mathrm{A}^- \end{cases} \quad \Rightarrow \quad \boldsymbol{D(Aw - e\gamma) \geq e}$$

where **D** is a diagonal matrix defined as:

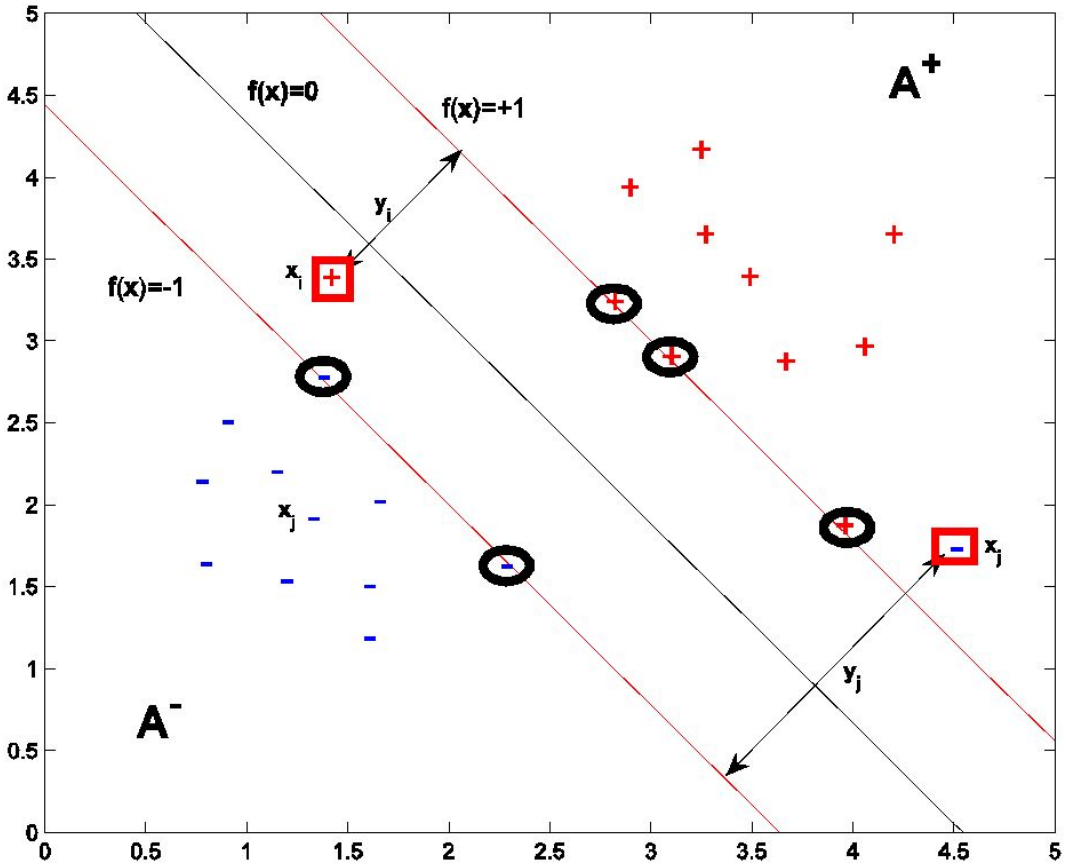
$$\mathrm{D}_{ii} = \begin{cases} +1 & ,if\, \mathrm{A}_i \in \mathrm{A}^+ \\ -1 & ,if\, \mathrm{A}_i \in \mathrm{A}^- \end{cases}$$

Standard Support Vector Machines



zero solution

Standard Support Vector Machines



y_i , y_j : slack variables

Standard Support Vector Machines

SVM formulation:

$$\min_{(\boldsymbol{w},\gamma,\boldsymbol{y})} \quad \|\boldsymbol{w}\|_2^2 + v\|\boldsymbol{y}\|_2^2$$

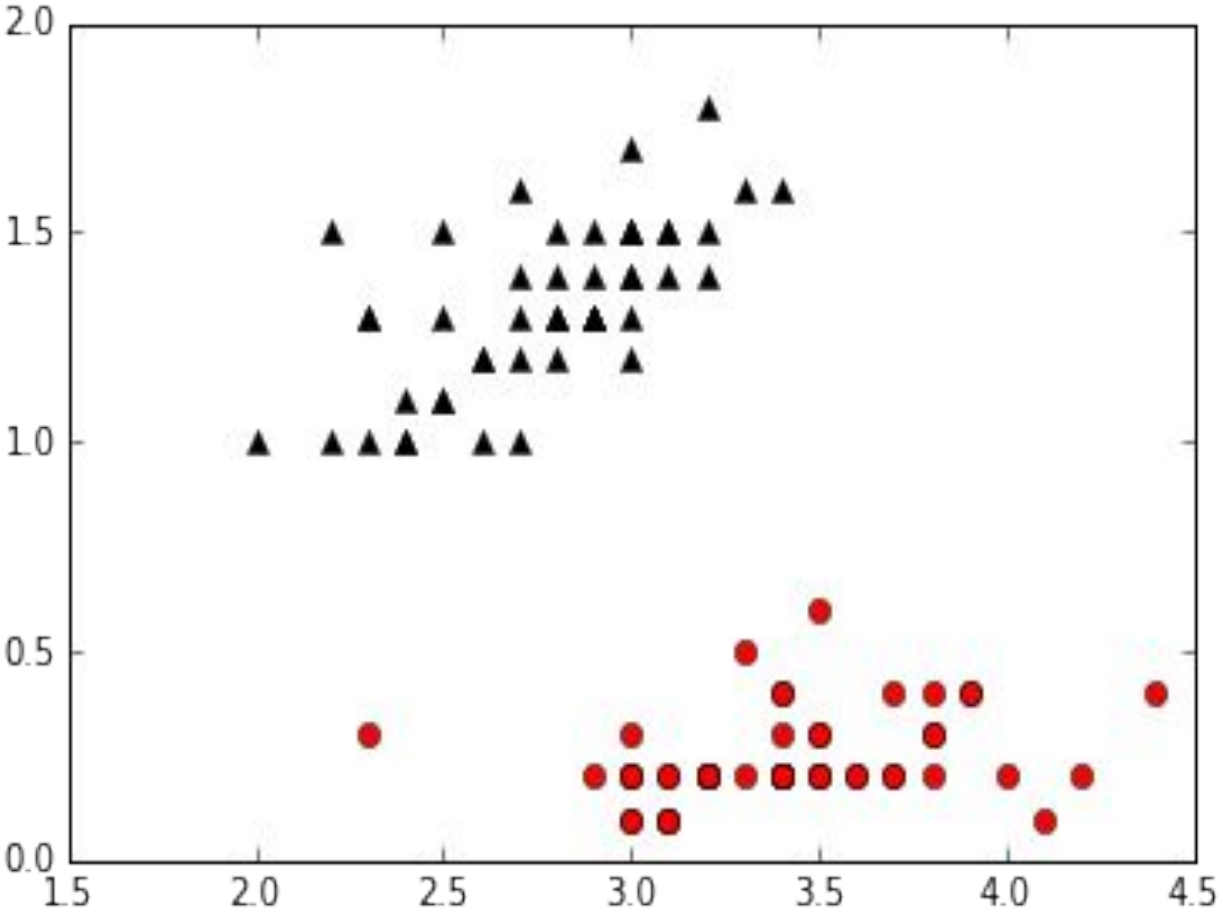
$$\boldsymbol{s.t.} \quad \boldsymbol{D}(\boldsymbol{A}\boldsymbol{w} - \boldsymbol{e}\gamma) + \boldsymbol{y} \geq \boldsymbol{e}$$

$$\boldsymbol{y} \geq 0$$

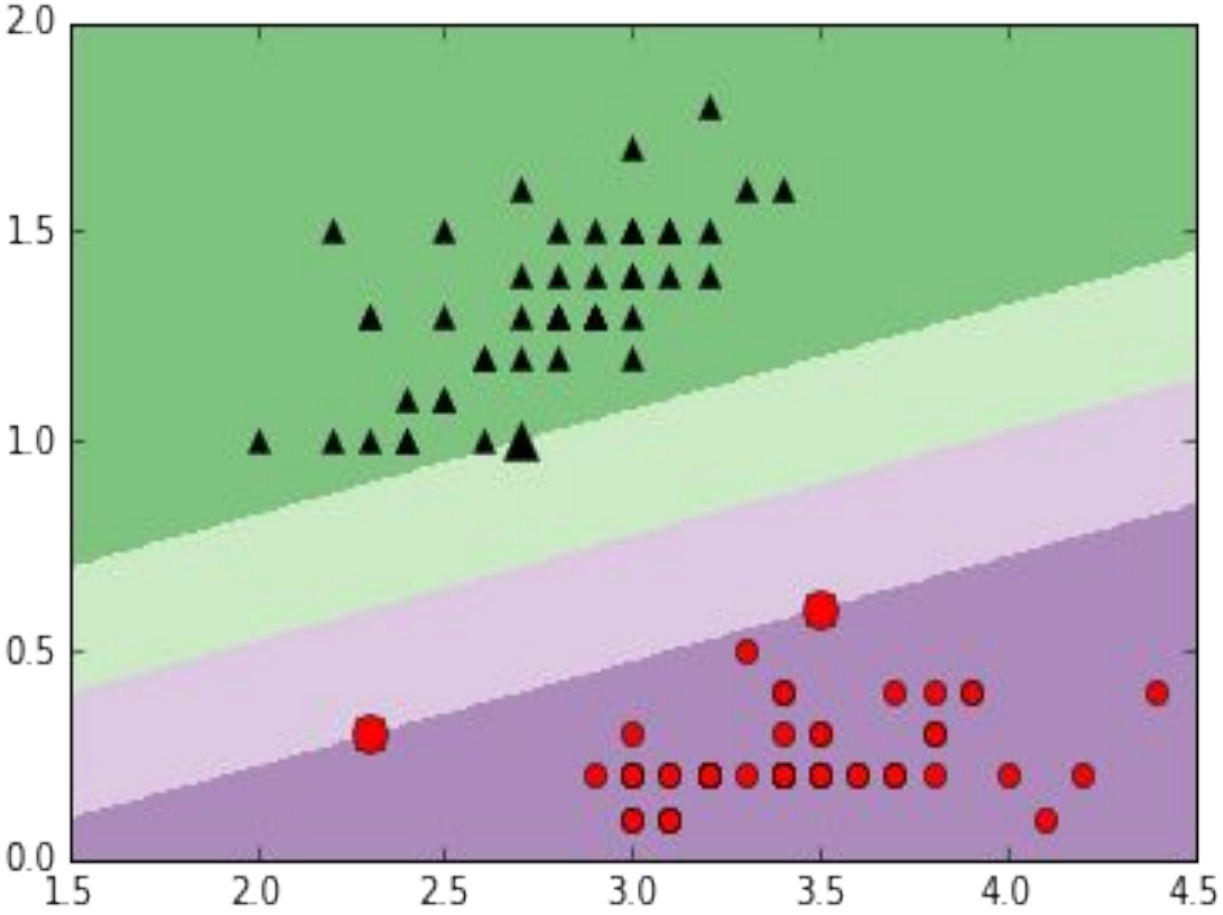
where **D** is a diagonal matrix defined as:

$$\mathrm{D}_{ii} = \begin{cases} +1 & , if\, \mathrm{A}_i \in \mathrm{A}^+ \\ -1 & , if\, \mathrm{A}_i \in \mathrm{A}^- \end{cases}$$

Small example: Iris data set

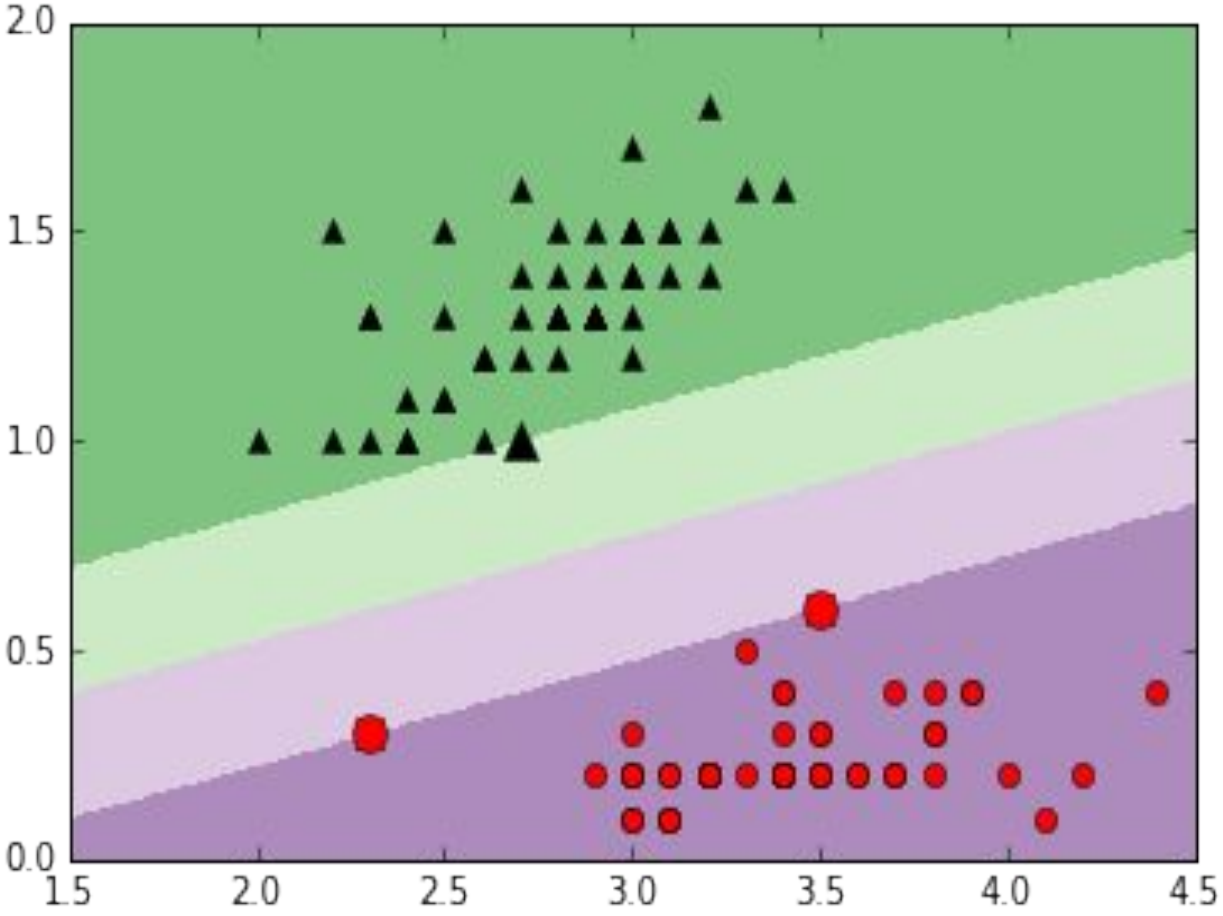


Small example: Iris data set



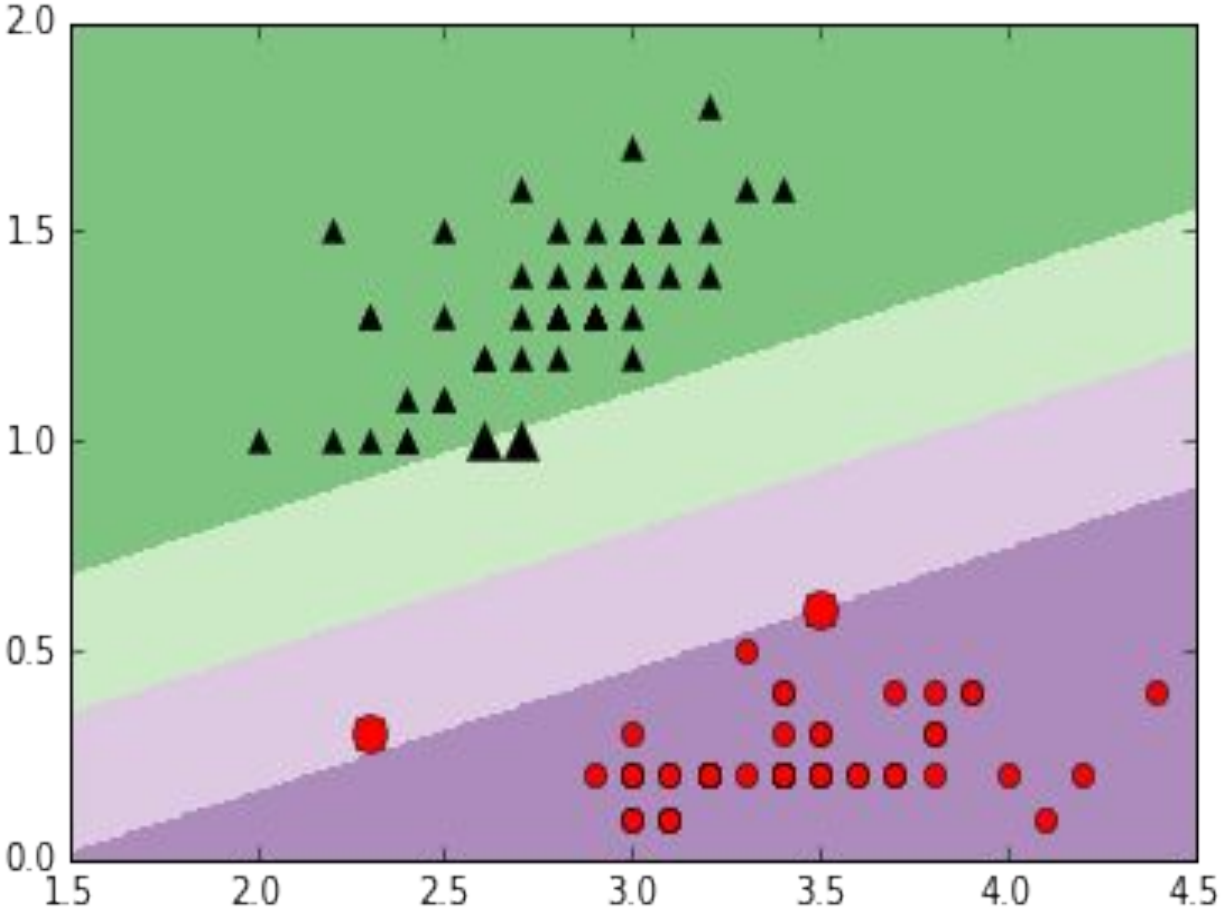
Back to Iris

$C = 10$



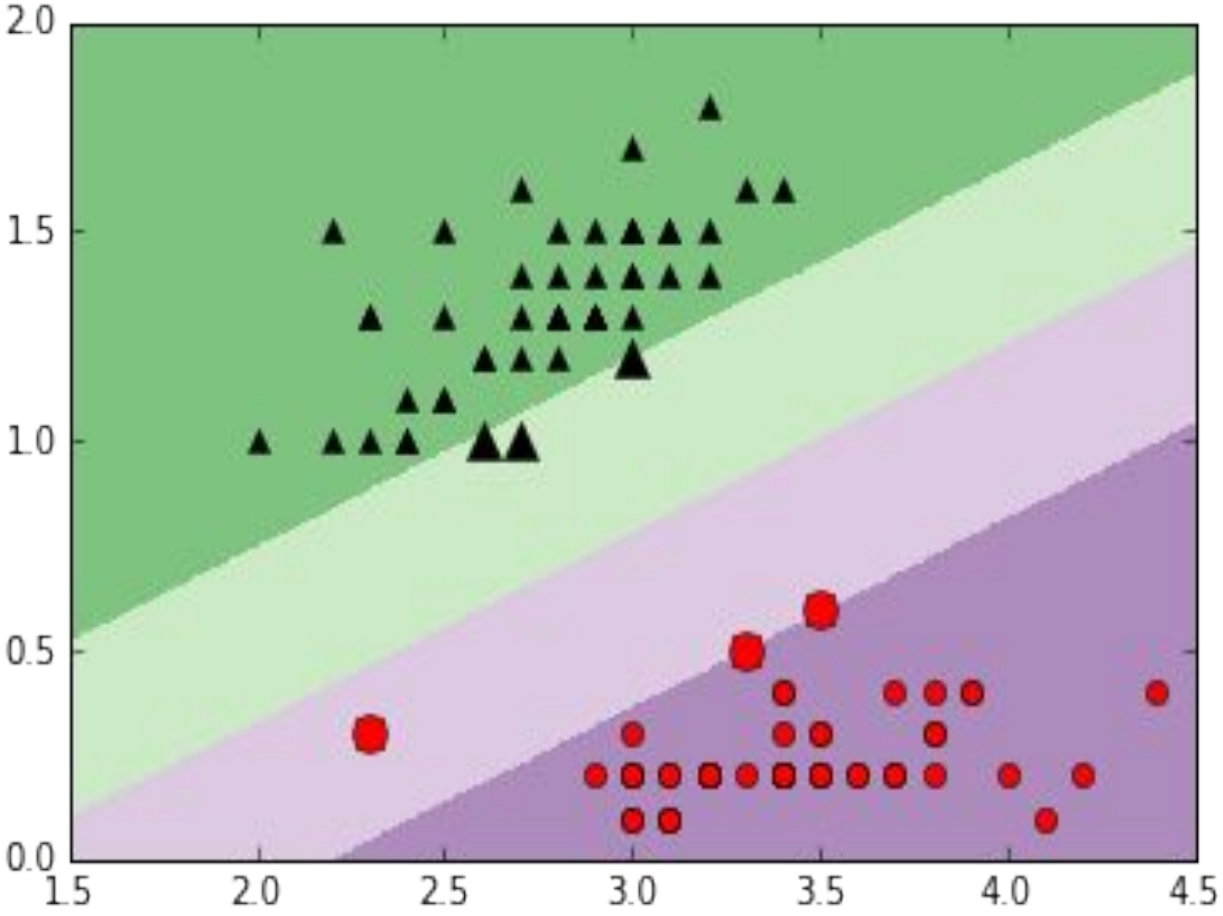
Back to Iris

C = 3 ~~decr~~ decreasing C, 더 많은 outlier



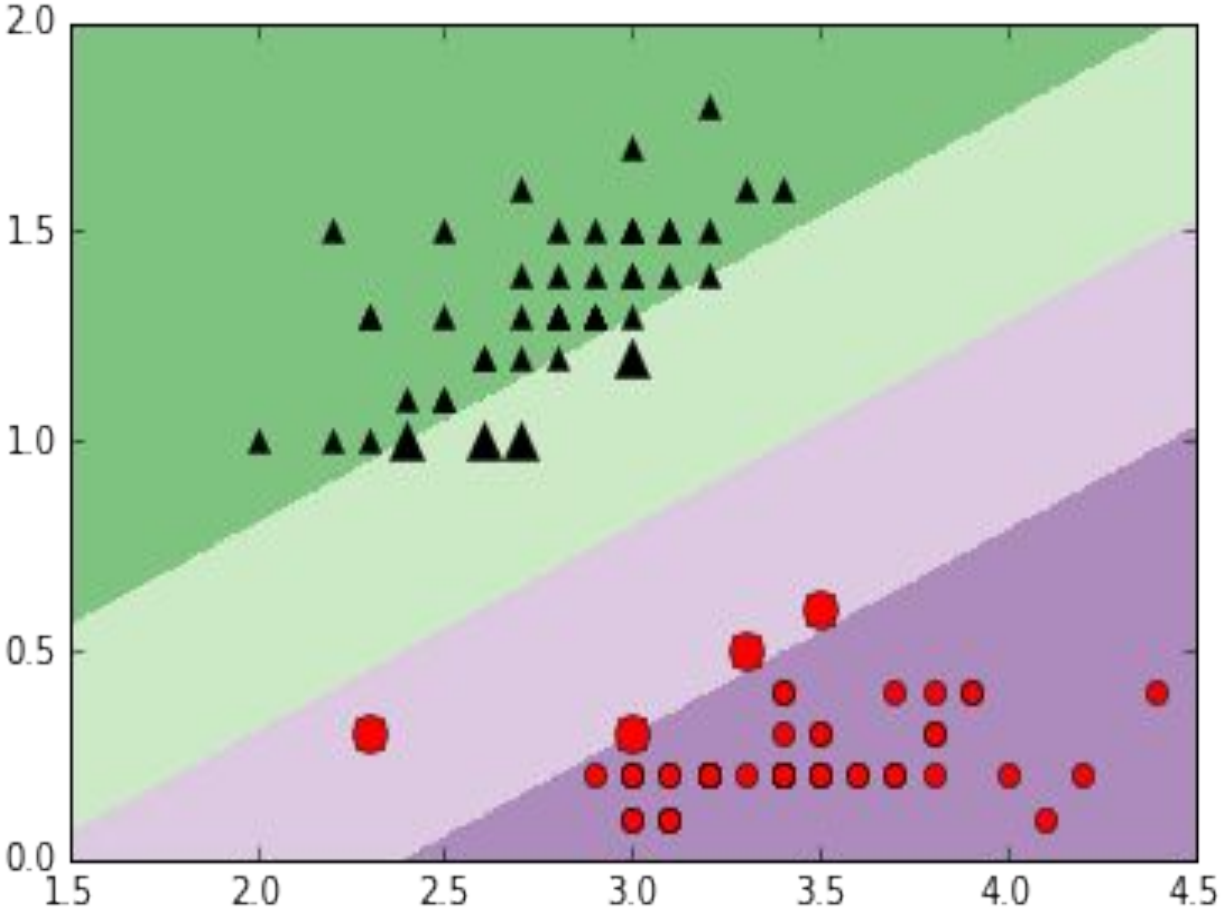
Back to Iris

$C = 2$



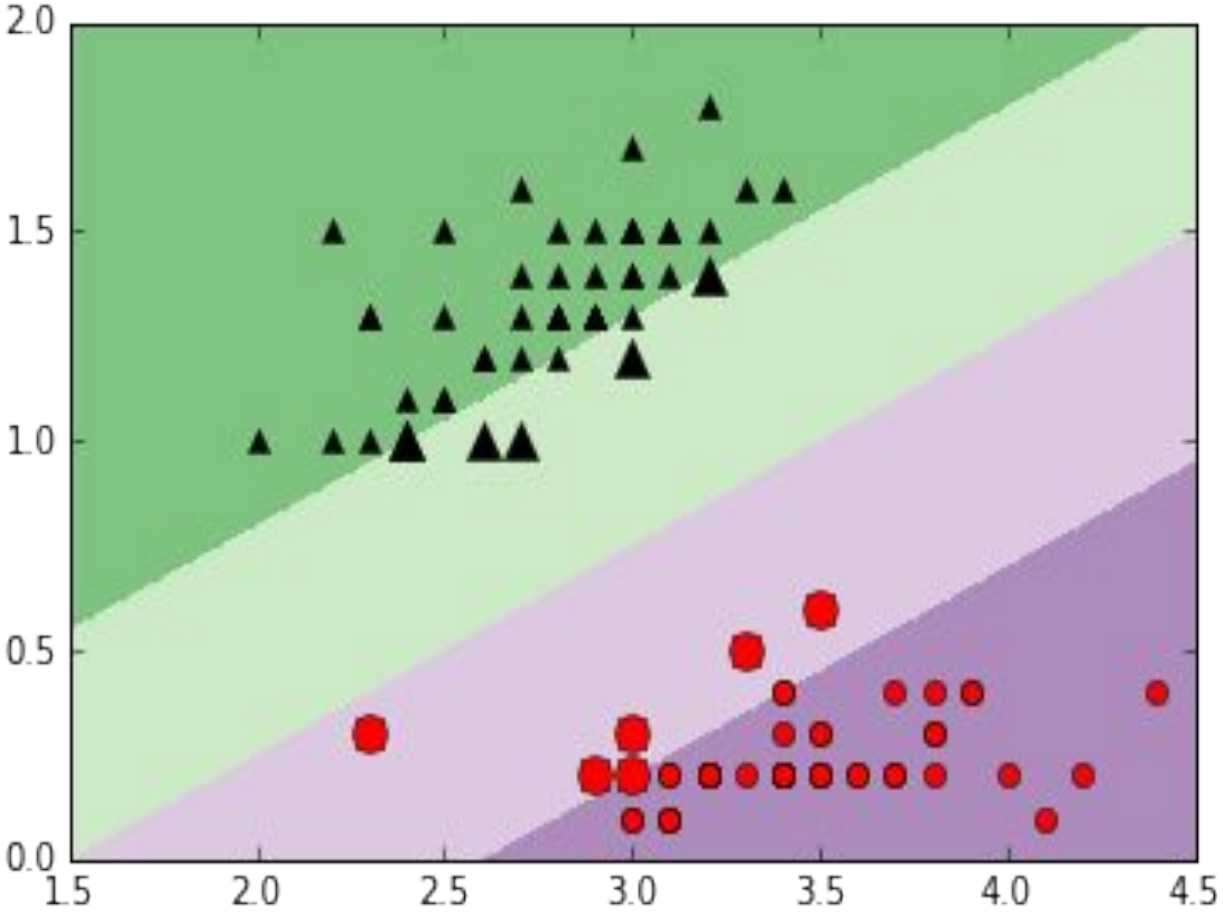
Back to Iris

$C = 1$



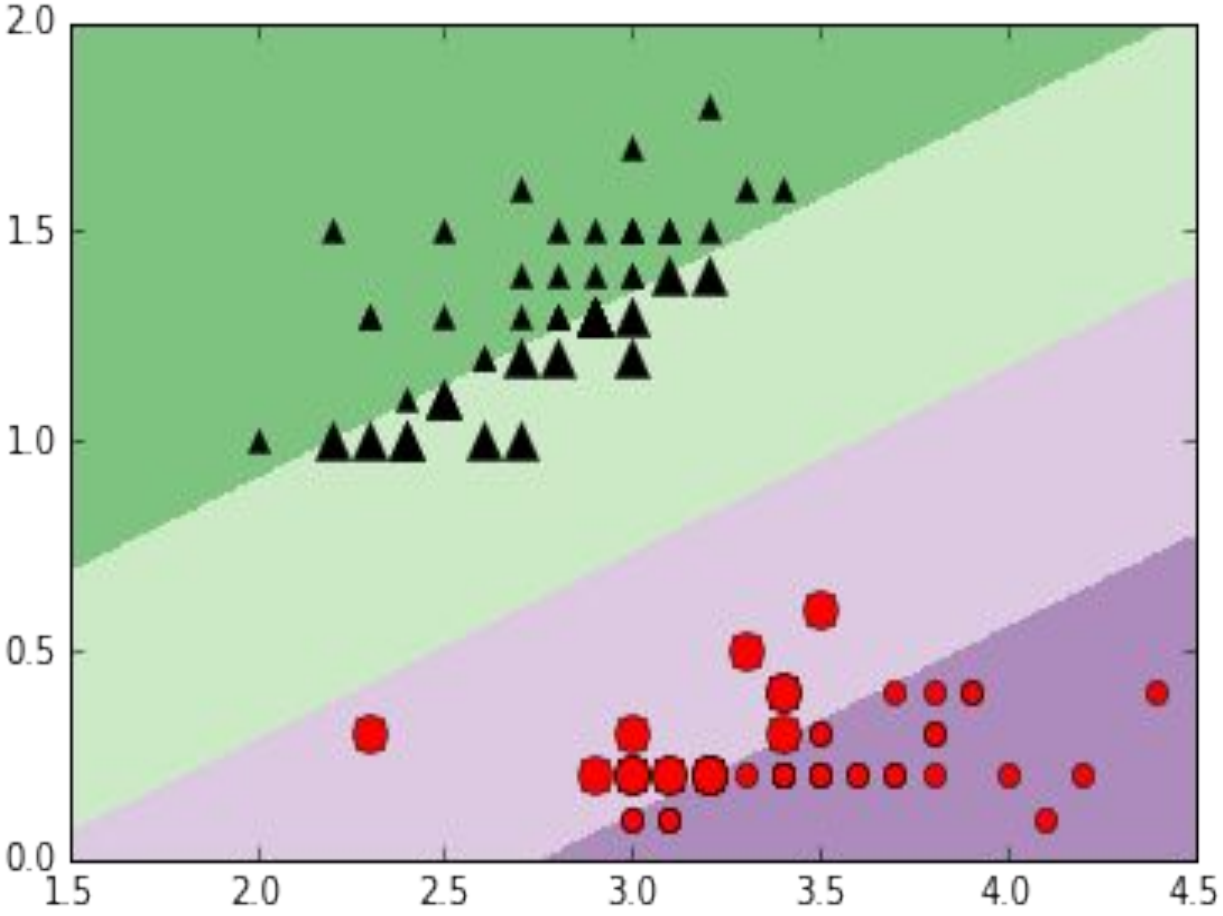
Back to Iris

$C = 0.5$



Back to Iris

$C = 0.1$



Back to Iris

$C = 0.01$