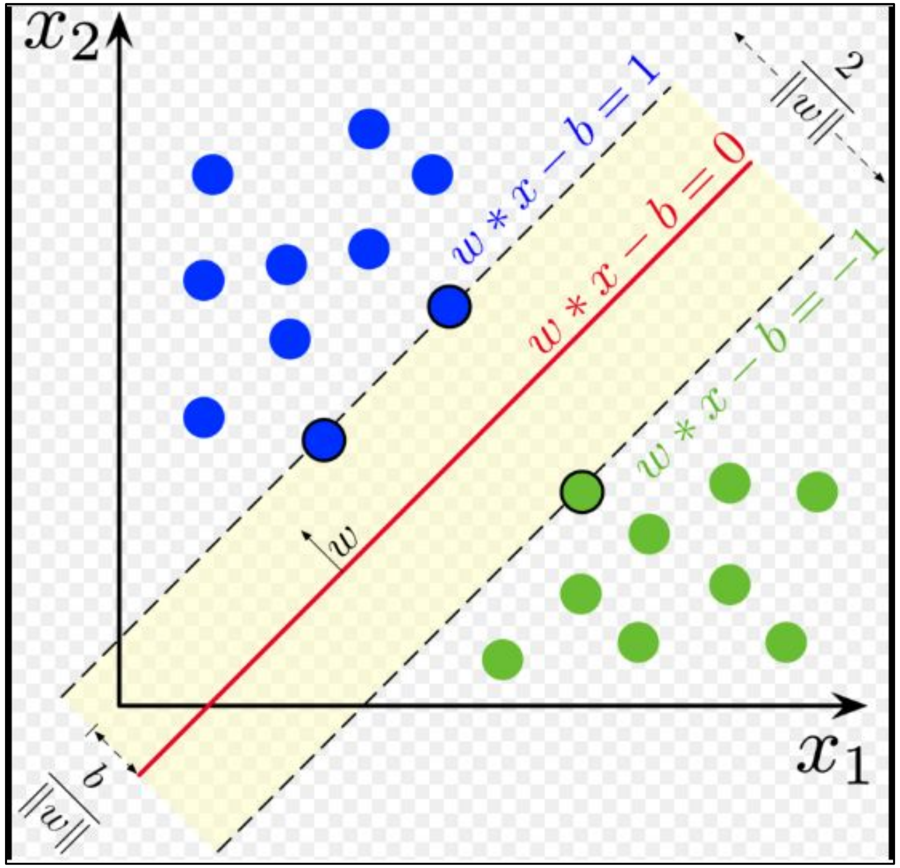
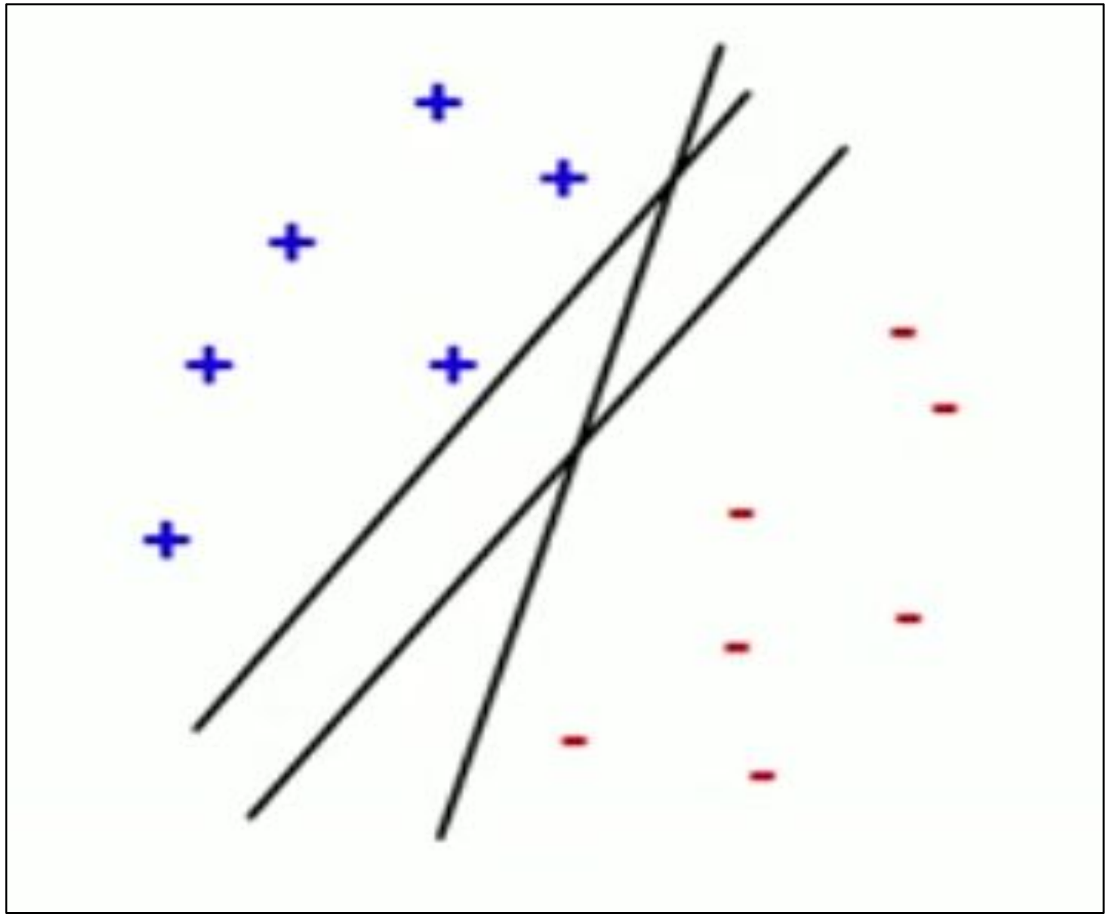
Classifier: Support Vector machine (SVM)

- An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible(Maximum Margin Classifier).
- Supervised Algorithm

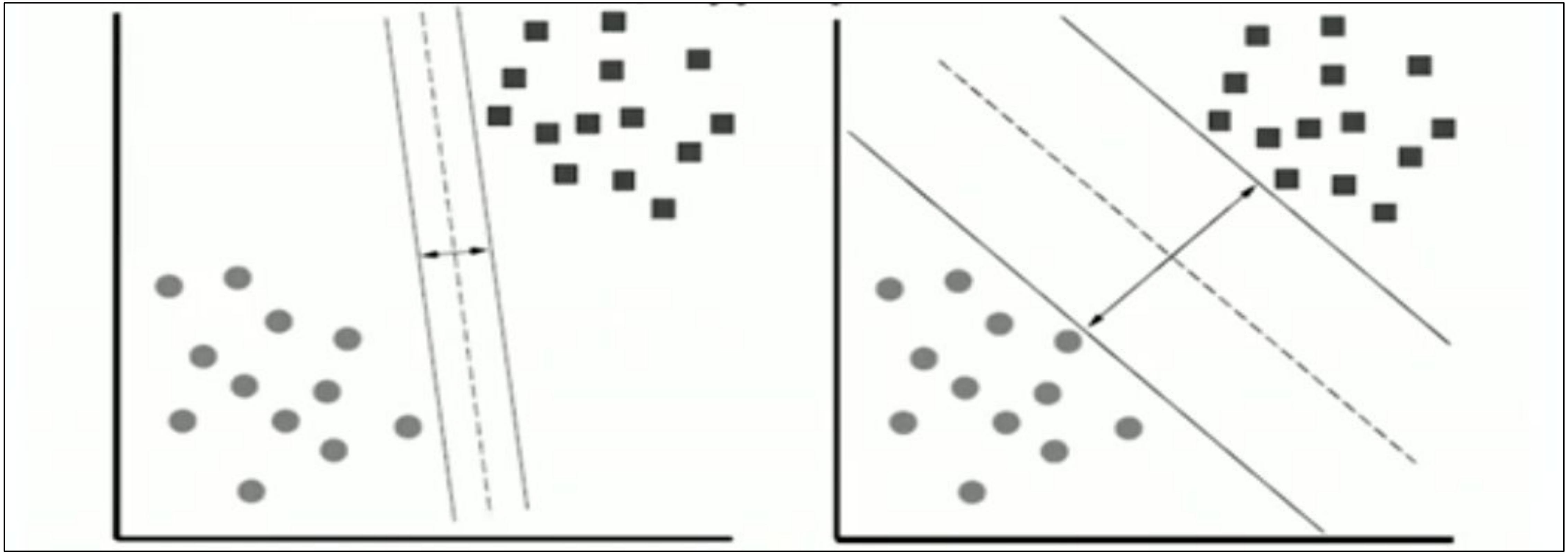


What's the Goal?

1. Want to seperate '+' from '-' using a line in a 2 class problem.
2. The feature vector may be n-dimensional.
3. Multi Classes SVM works for more than 2 classes.

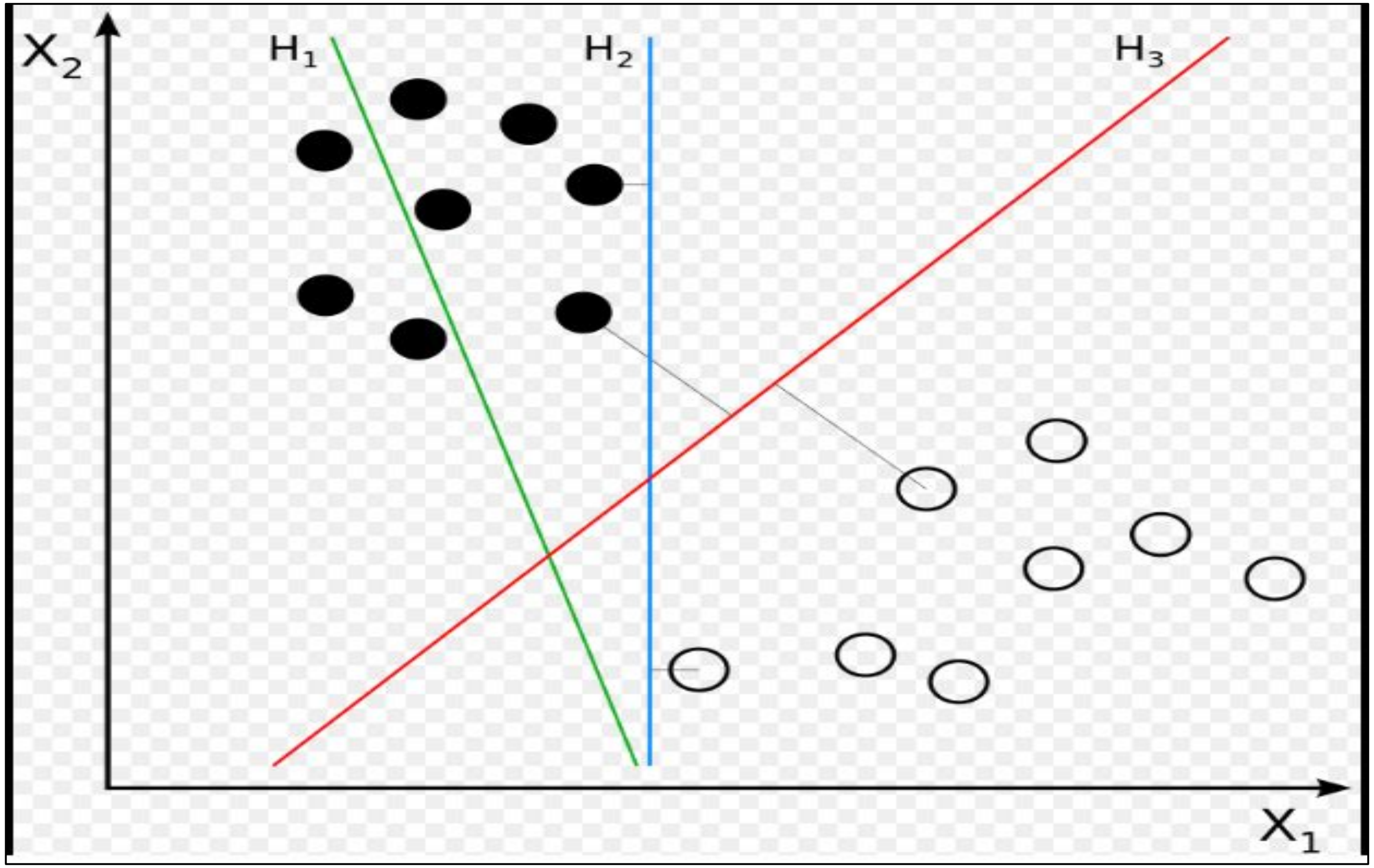


Maximizing the margin (Y)



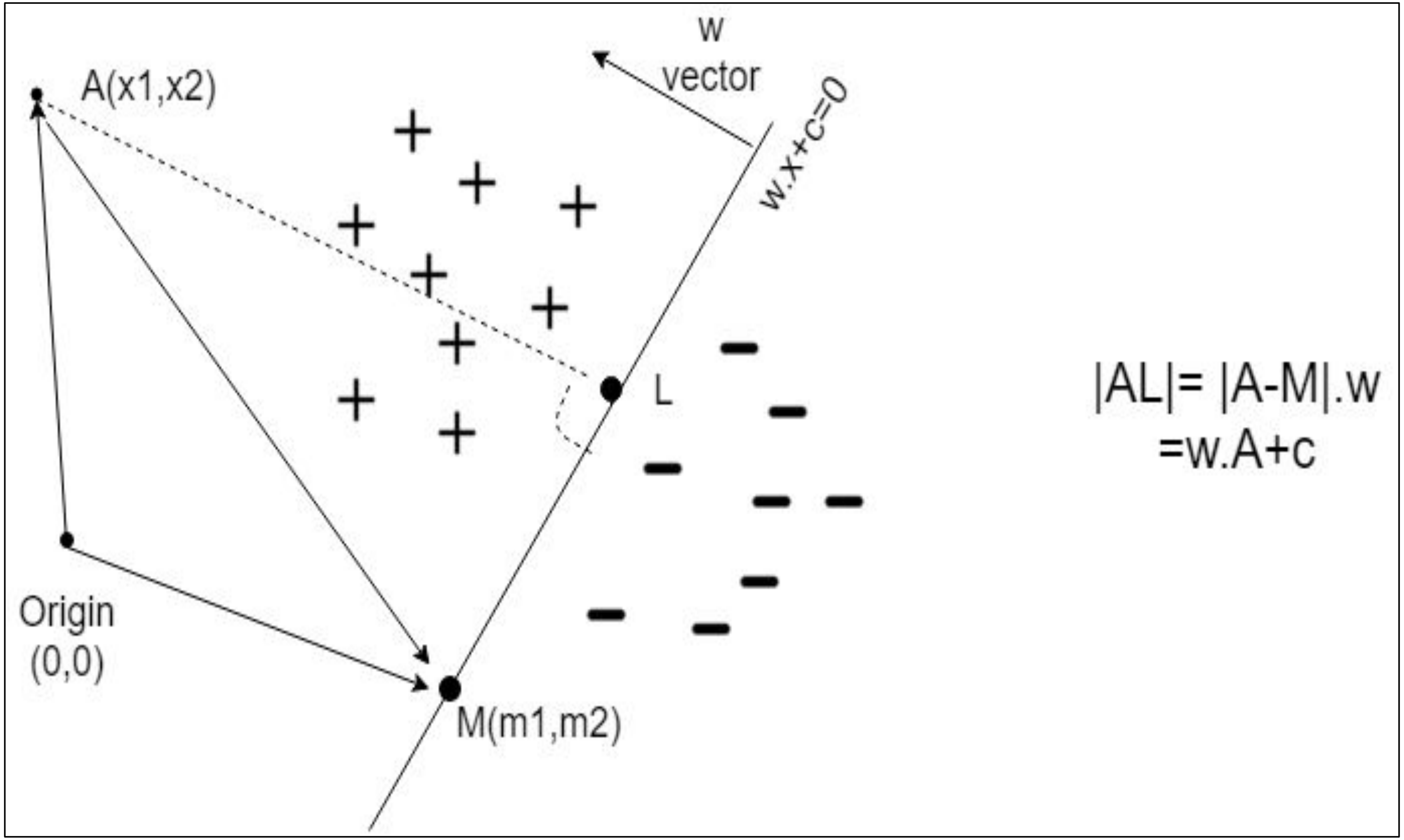
Source: https://www.youtube.com/watch?v=ax8LxRZCORU

One More Example(H3 is best line seperating the classes with maximum margin)



Problem Formulation

1. A= data point from dataset
2. M=point on line
3. Aim is to find perpendicular distance |AL|.



Problem formulation Continued:

1. Dataset looks like :
2. Now we define:

"Prediction" = sign(w.x+c)

"Confidence"= (w.x+c).y

1. If w.x+c=0, point is on line and class can't be decided.
2. If w.c+c>0, point belongs to +ve class
3. Else, it belongs to -ve class.

X1	X2	Class- Y
1	2	+1
2.4	4.5	-1
2.5	8	-1
0	2.1	+1

Problem Statement

1. For ith datapoint:

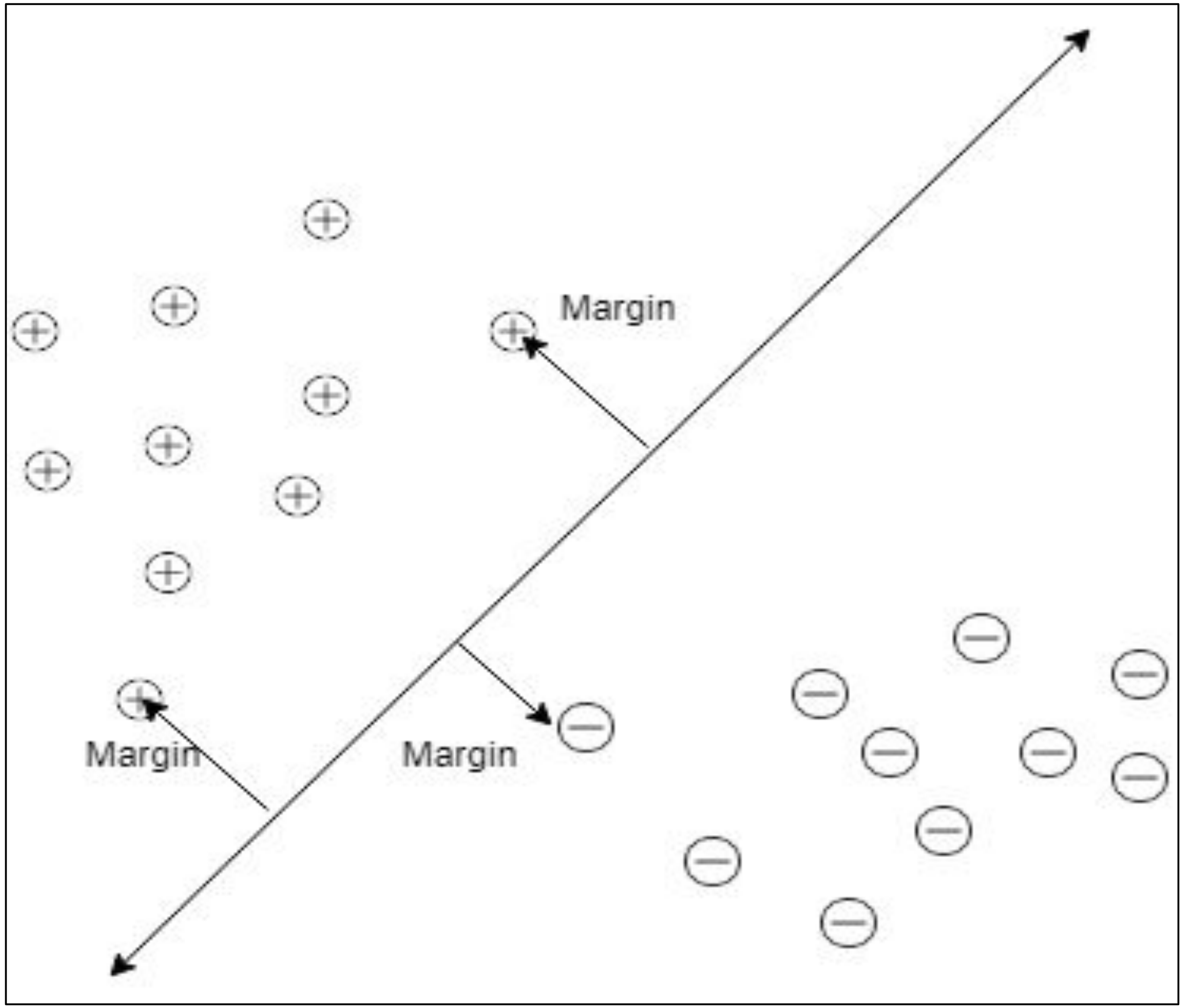
Margin(i)= (w.x(i) +c)*y(i)

2. So we want to solve:

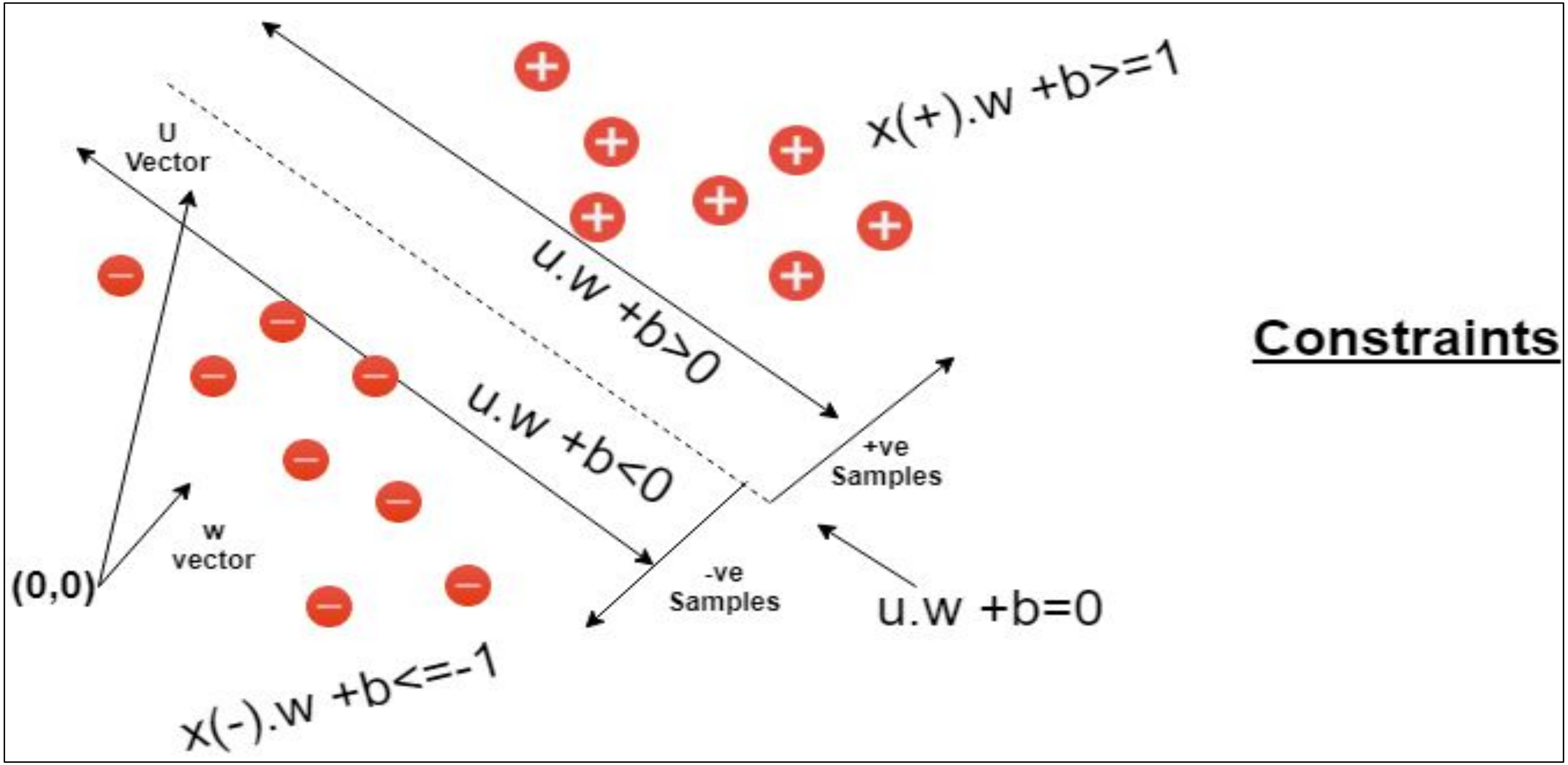
max(min(Margin(i)))

w i

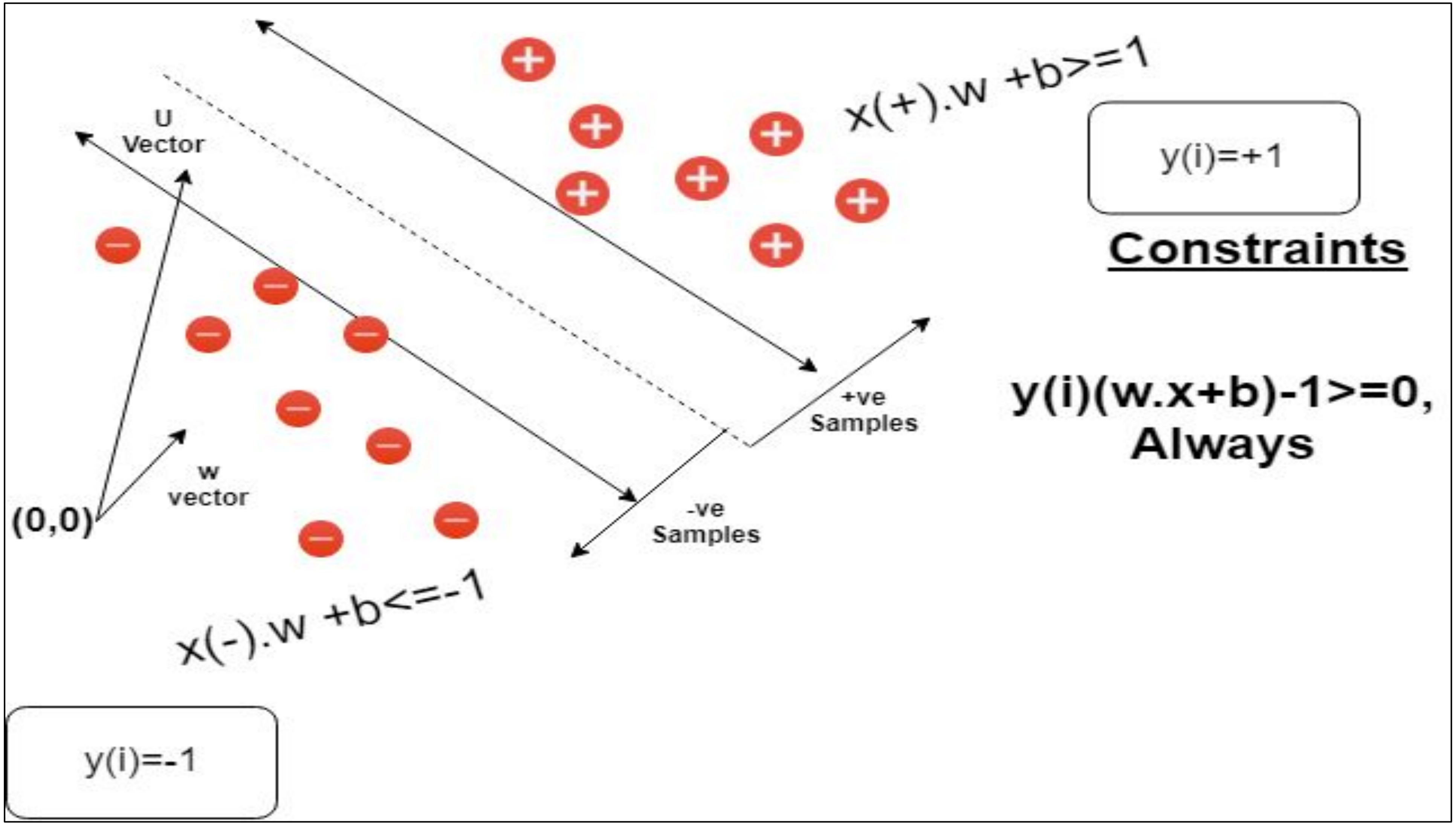
3. Hence a Constrained Optimization Problem.



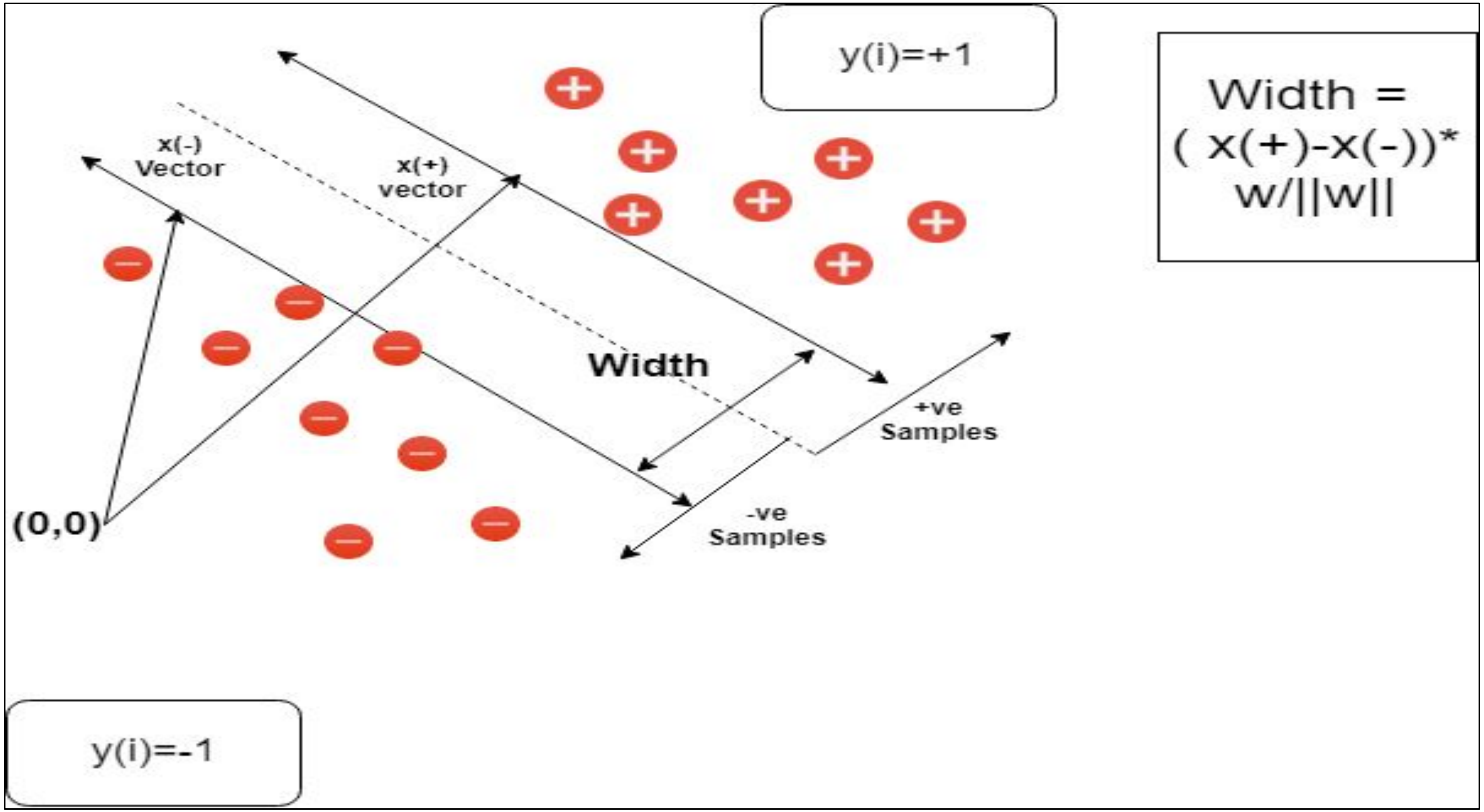
Additional Constraints



Additional Constraints



Finding the width between Two Support Vectors



Using Lagrange multiplier

(is a strategy for finding the local maxima and minima of a function subject to equality constraints)

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

$$= \frac{(\bar{x}_+ \cdot \bar{w} - \bar{x}_- \cdot \bar{w})}{\|w\|} = \frac{1-b+1+b}{\|w\|} = \frac{2}{\|w\|}$$

$$\text{So MAX } \frac{2}{\|w\|} \Rightarrow \text{MIN } \|w\| \text{ or } \boxed{\text{MIN}\left(\frac{1}{2}\|w\|^2\right)}$$

$$L = \frac{1}{2}\|w\|^2 - \sum \alpha_i \left[y_i (\bar{w} \cdot \bar{x}_i + b) - 1 \right]$$

Constraint

α_i = multiplier

$$\boxed{\text{Now, } \frac{\partial L}{\partial \bar{w}} = 0 \Rightarrow \vec{w} = \sum \alpha_i y_i \bar{x}_i}$$

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

Putting the terms found previous back into equation

After solving it,

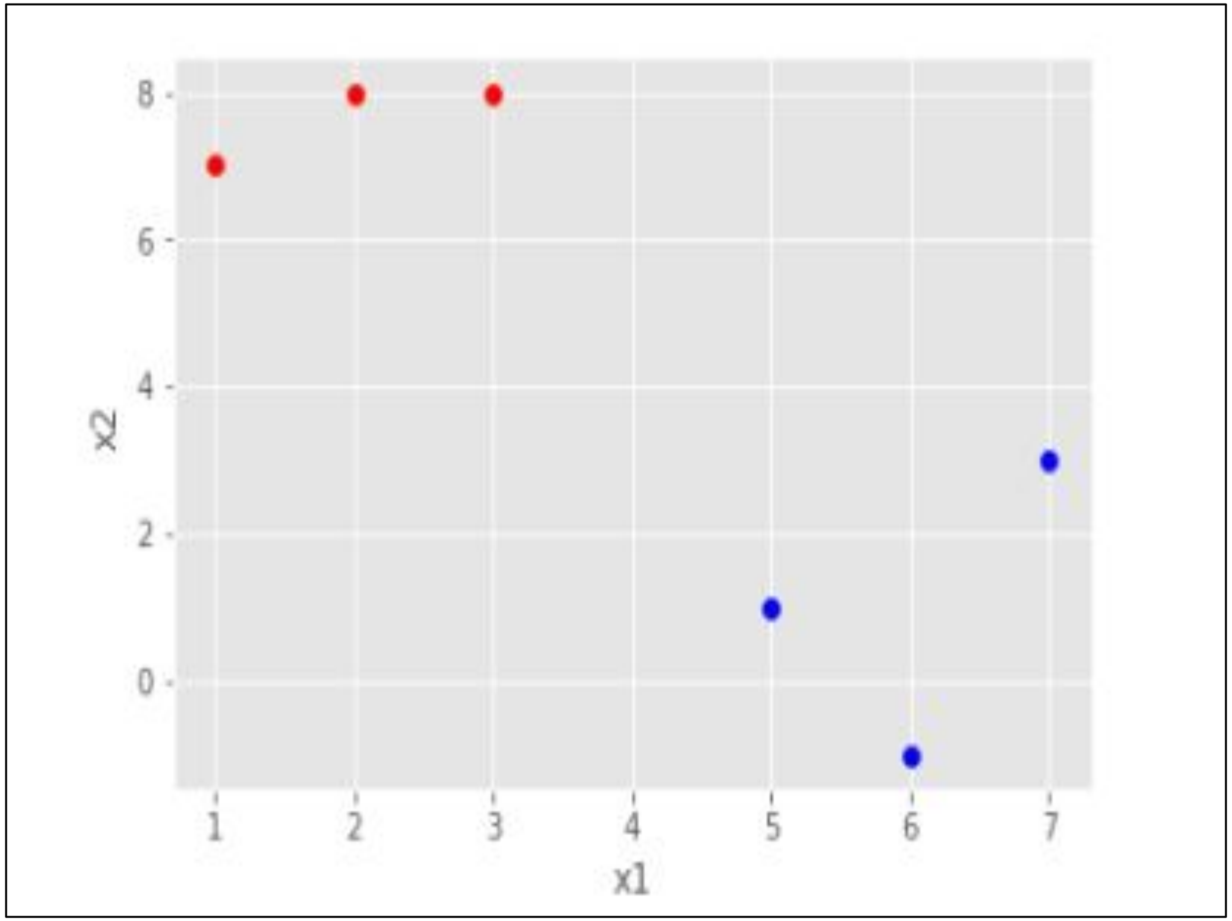
$$\boxed{L = \sum \alpha_i - \frac{1}{2} \sum_i \sum_j \alpha_i \alpha_j y_i y_j \boxed{x_i x_j}}$$

So

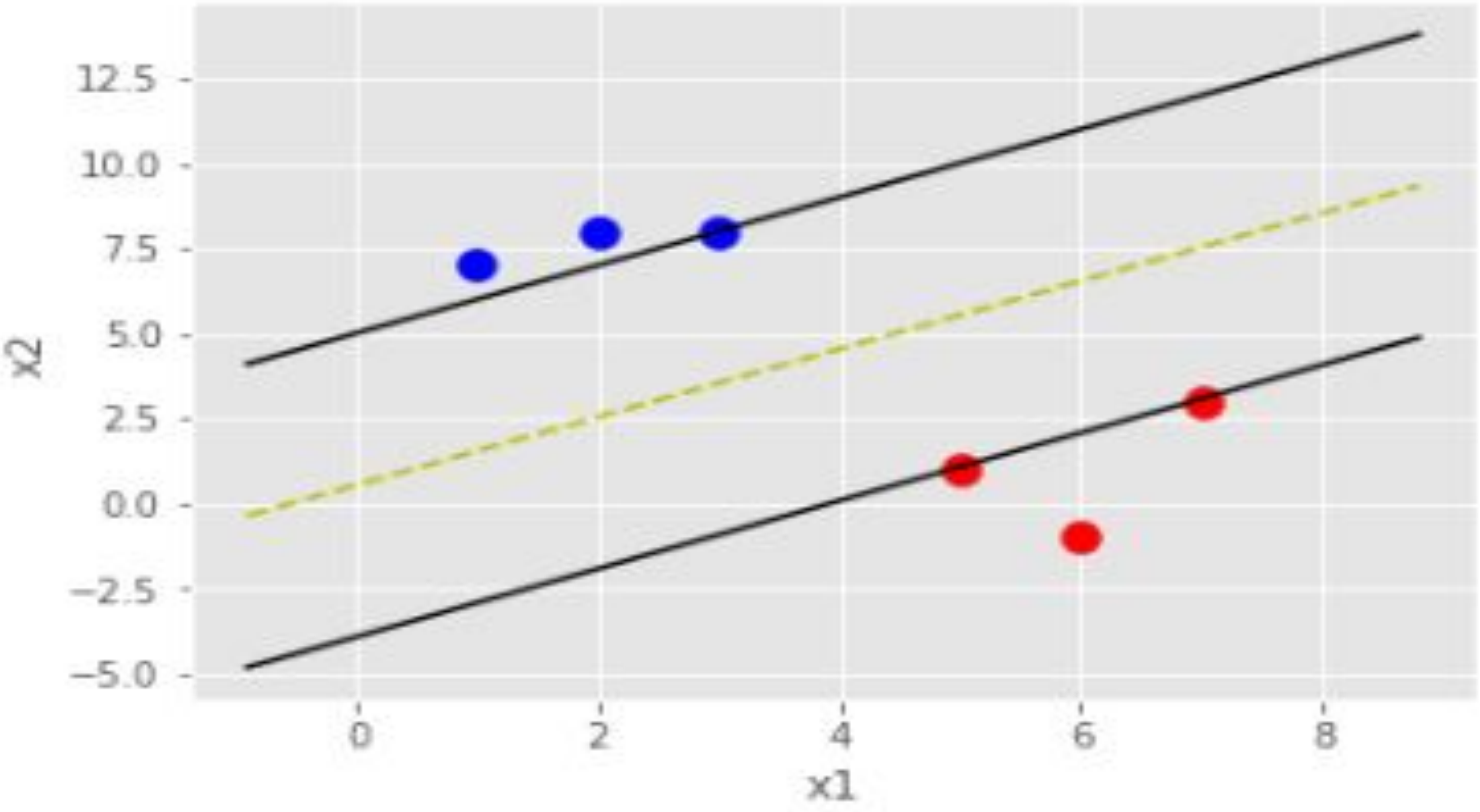
$$\boxed{\sum \alpha_i y_i \, \overline{x}_i \cdot \overline{u} + b \geq 0 \text{ Then '+' else '-'}}$$

Experiment on 2D data Points

Data Points: Red -ve samples
Blue +ve samples

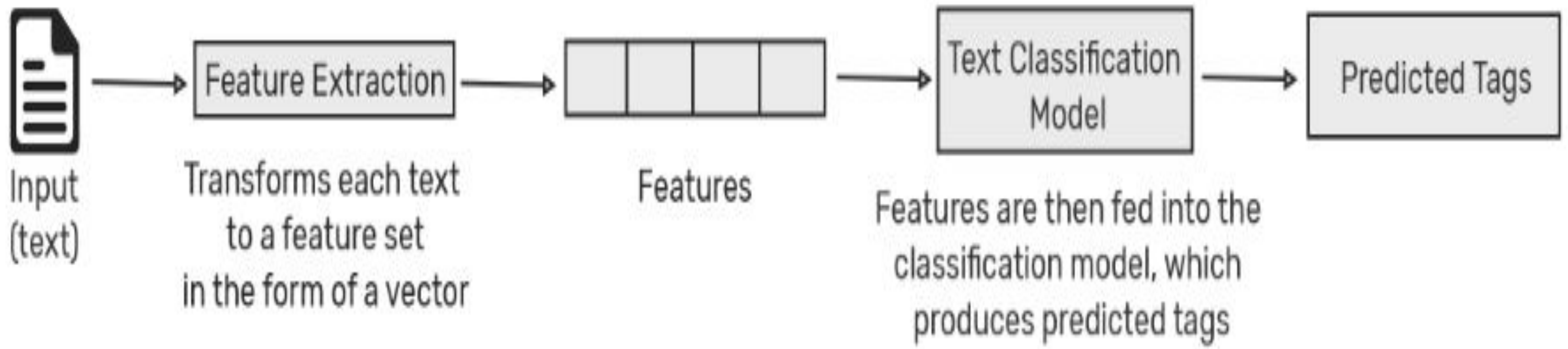


Result after applying SVM algorithm



Text Classification using SVM

- Text classification (text categorization or text tagging) is the task of assigning a set of predefined categories to free-text. Text classifiers can be used to organize, structure, and categorize pretty much anything.



Source:https://monkeylearn.com/text-classification/

Thanks