

The Hong Kong Polytechnic University
Department of Applied Mathematics

AMA4680 Statistical Machine Learning

Support vector machine

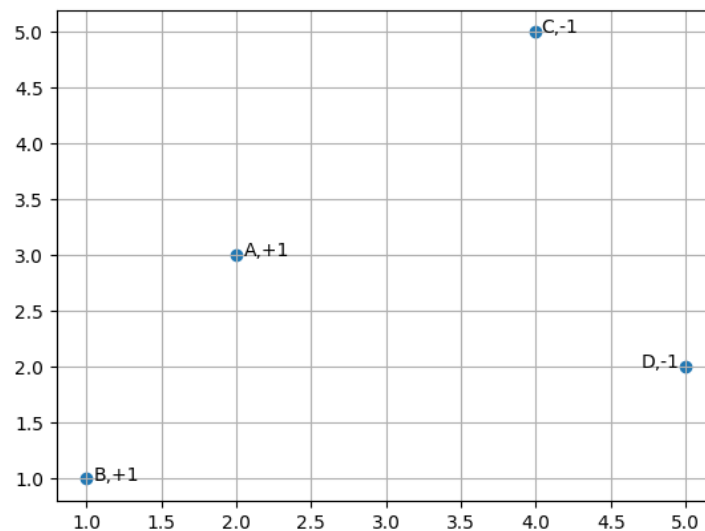
1. (Hard margin) Given the following dataset with two features x_1 and x_2 :

Sample	x_1	x_2	Class
1	2	3	+1
2	1	1	+1
3	4	5	-1
4	5	2	-1

- (a) **Plot the Data:** Sketch a 2D plot of the data points on the x_1 and x_2 axes, labeling the classes.
- (b) **Identify Support Vectors and Decision Boundary:** Determine which points are the support vectors if you were to fit a linear SVM.
- (c) **Classify a New Point:** Use the decision boundary to classify a new point (3.5, 4).

Solution.

(a) **Plot the Data:**



(b) Recall the math model of SVM

$$\begin{aligned} \min_{w,b} & \|w\|^2 \\ \text{s.t. } & y_i(w^\top x_i + b) \geq 1, \quad i = 1, \dots, m. \end{aligned} \tag{1}$$

2. Code for SVM with hard margin. Given the dataset

Sample	x_1	x_2	Class
A	1	2	+1
B	2	3	+1
C	3	3	+1
D	5	5	-1
E	6	7	-1
F	7	6	-1

- determine and plot the decision boundary, and
- highlight support vectors.

3. (Soft margin) Refer to tutorial in the future.

4. [Midterm exam](#):

- Oct 31, lecture time,
- 2 venues.
- Chapter 1-Chapter 4.
- Calculators are necessary.
- **Handwritten notes** within one piece of two-sided A4 paper are allowed.