Machine Learning Introduction

EE698V - Machine Learning for Signal Processing

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Machine Learning

INPUT

x_t

MODEL

$F(x_t)$

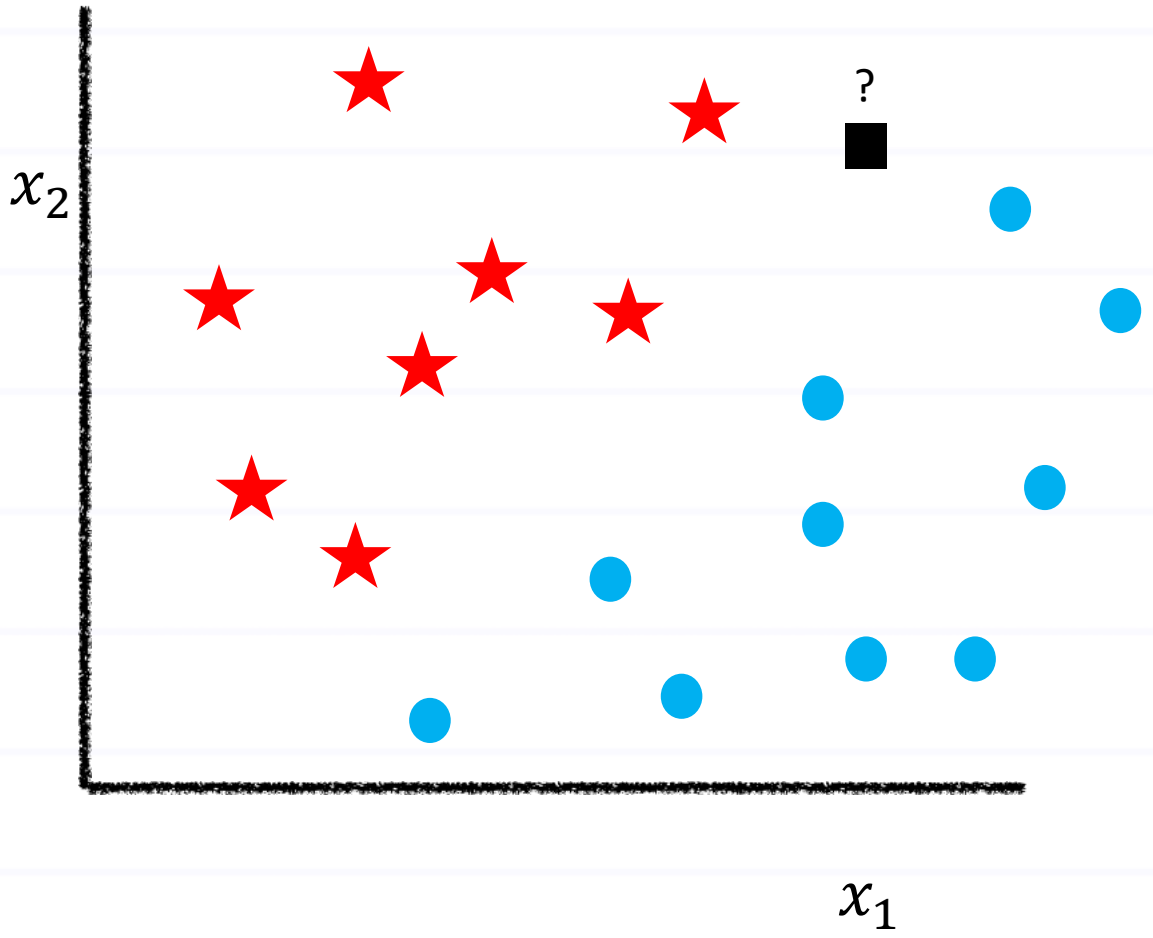
OUTPUT

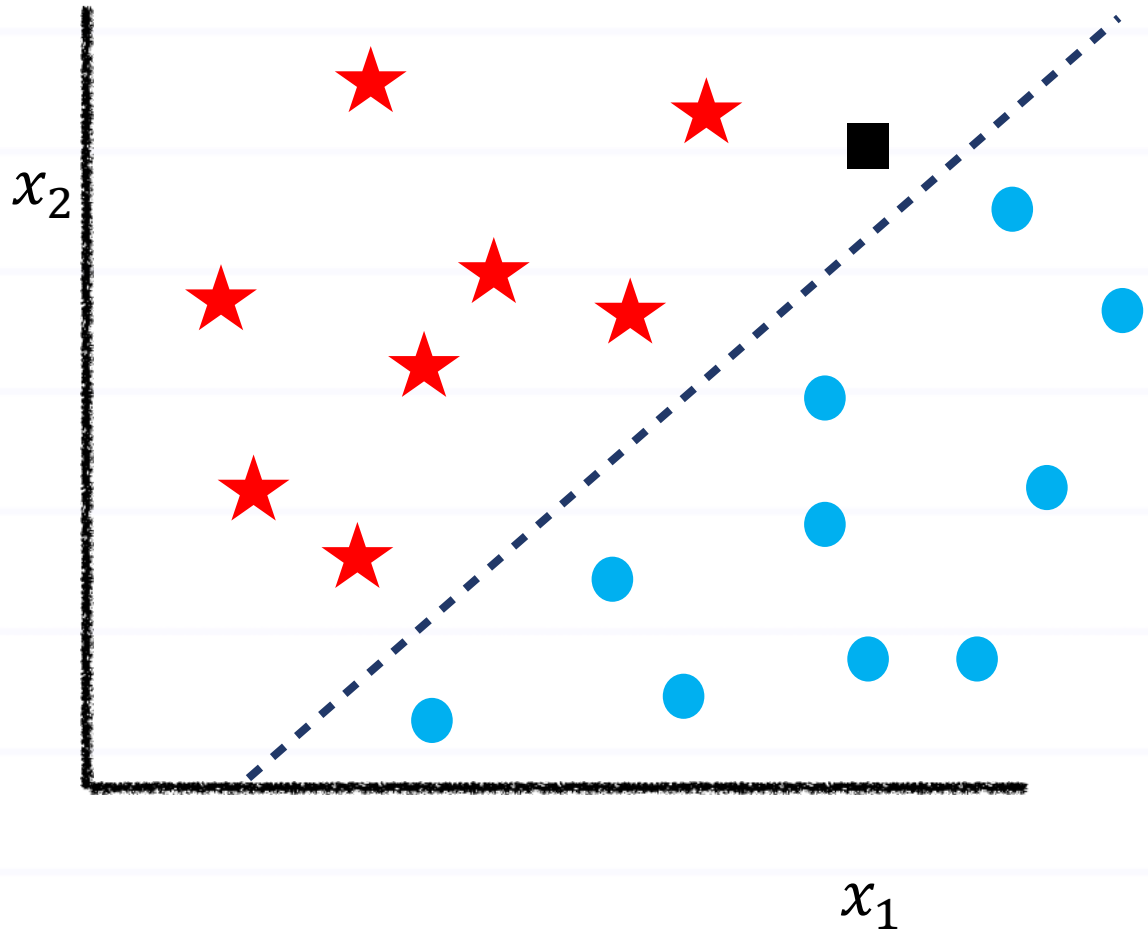
y_t

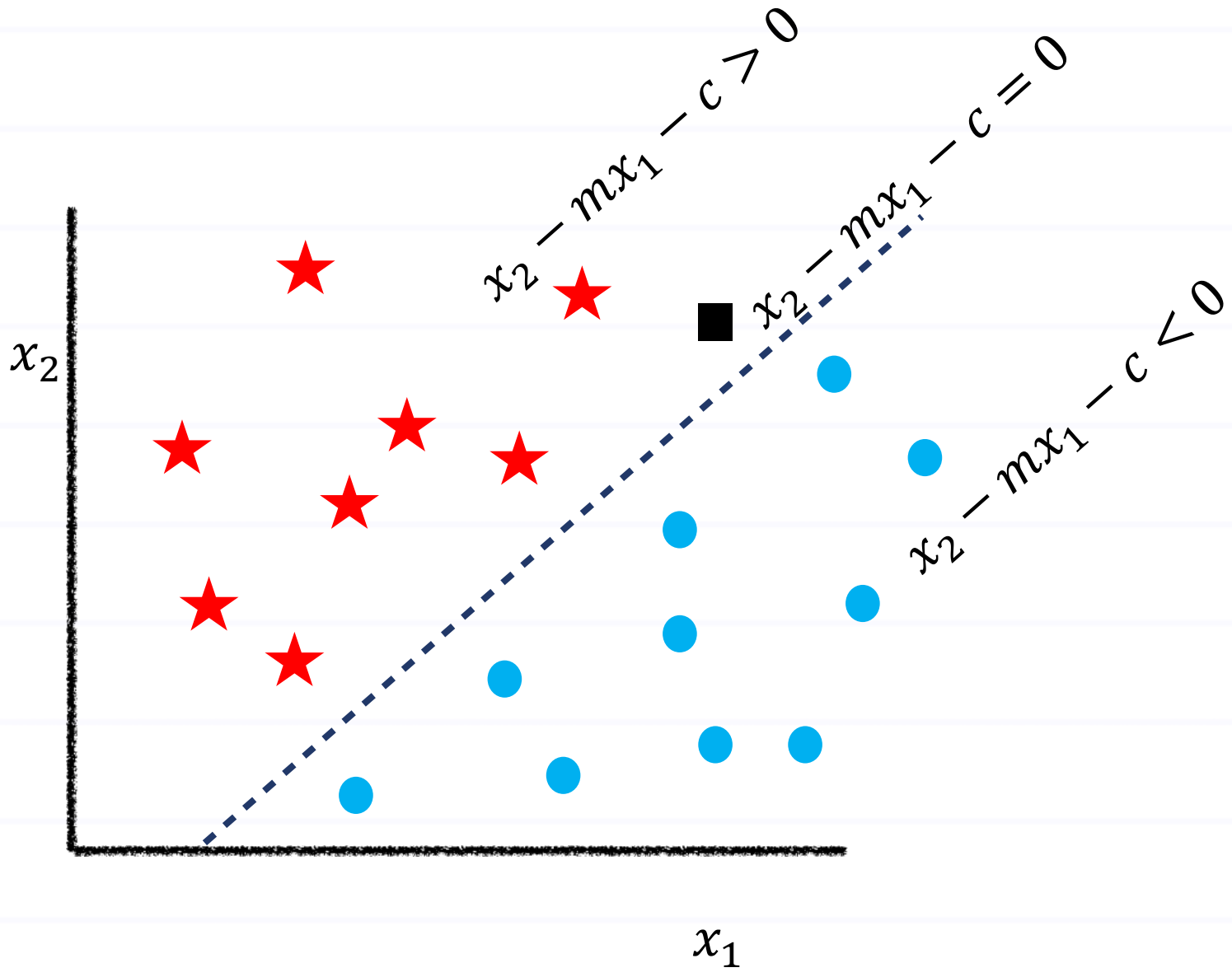
Classification

Feature Extraction

- height = x1
- diameter = x2


?
x_2
x_1


x_2
x_1


$x_2 - mx_1 - c > 0$
$x_2 - mx_1 - c = 0$
$x_2 - mx_1 - c < 0$
x_2
x_1

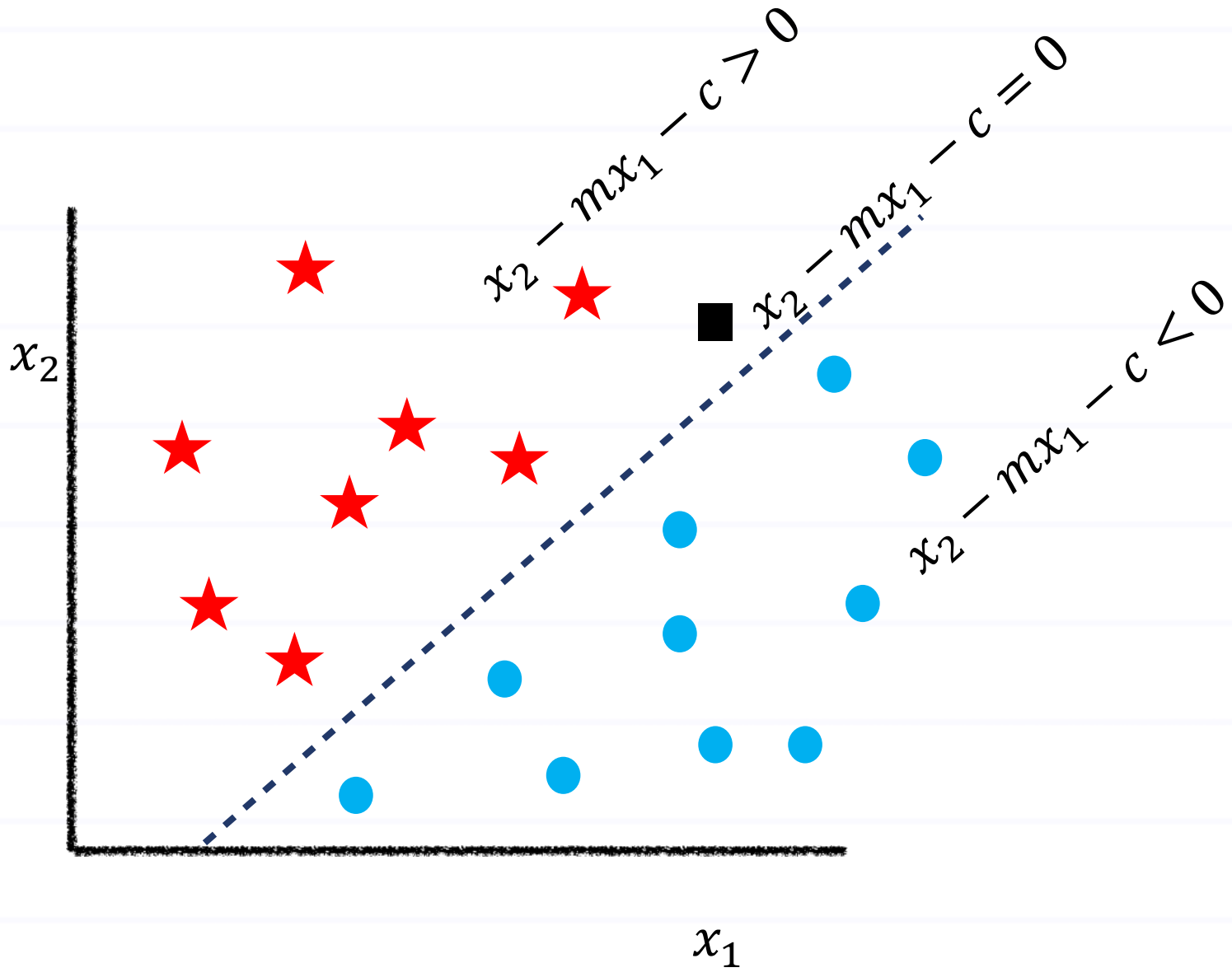
Hard Classification

■ = ★

Soft Classification

$P(■ = ★) = 0.6$

$P(■ = ●) = 0.4$



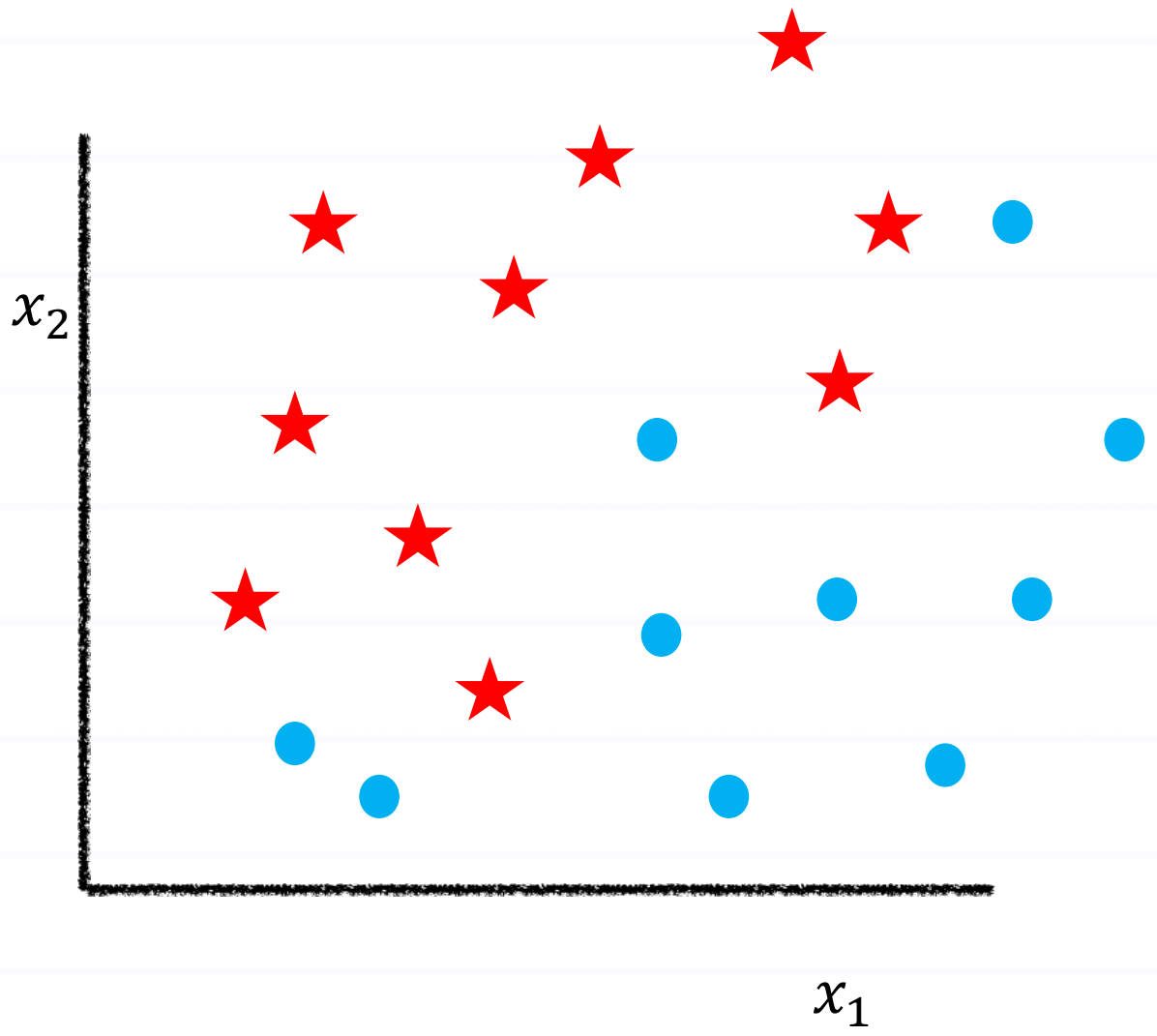
Soft Classification

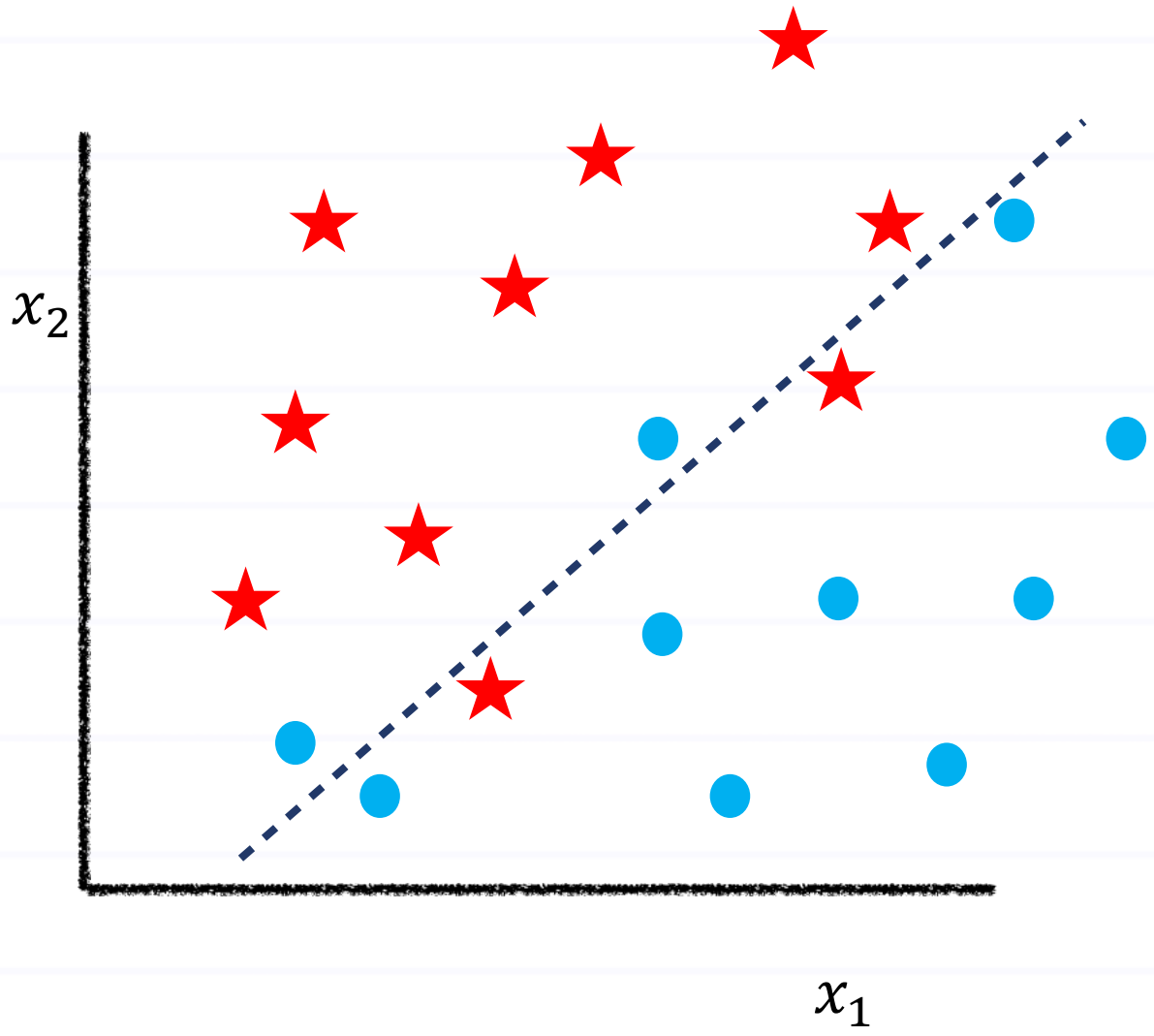
$$h = x_2 - mx_1 - c$$

$$P(\blacksquare = \bigstar) = \frac{1}{1 + \exp(-h)}$$

Sigmoid function

$$\sigma(h) = \frac{1}{1 + \exp(-h)}$$


x_2
x_1

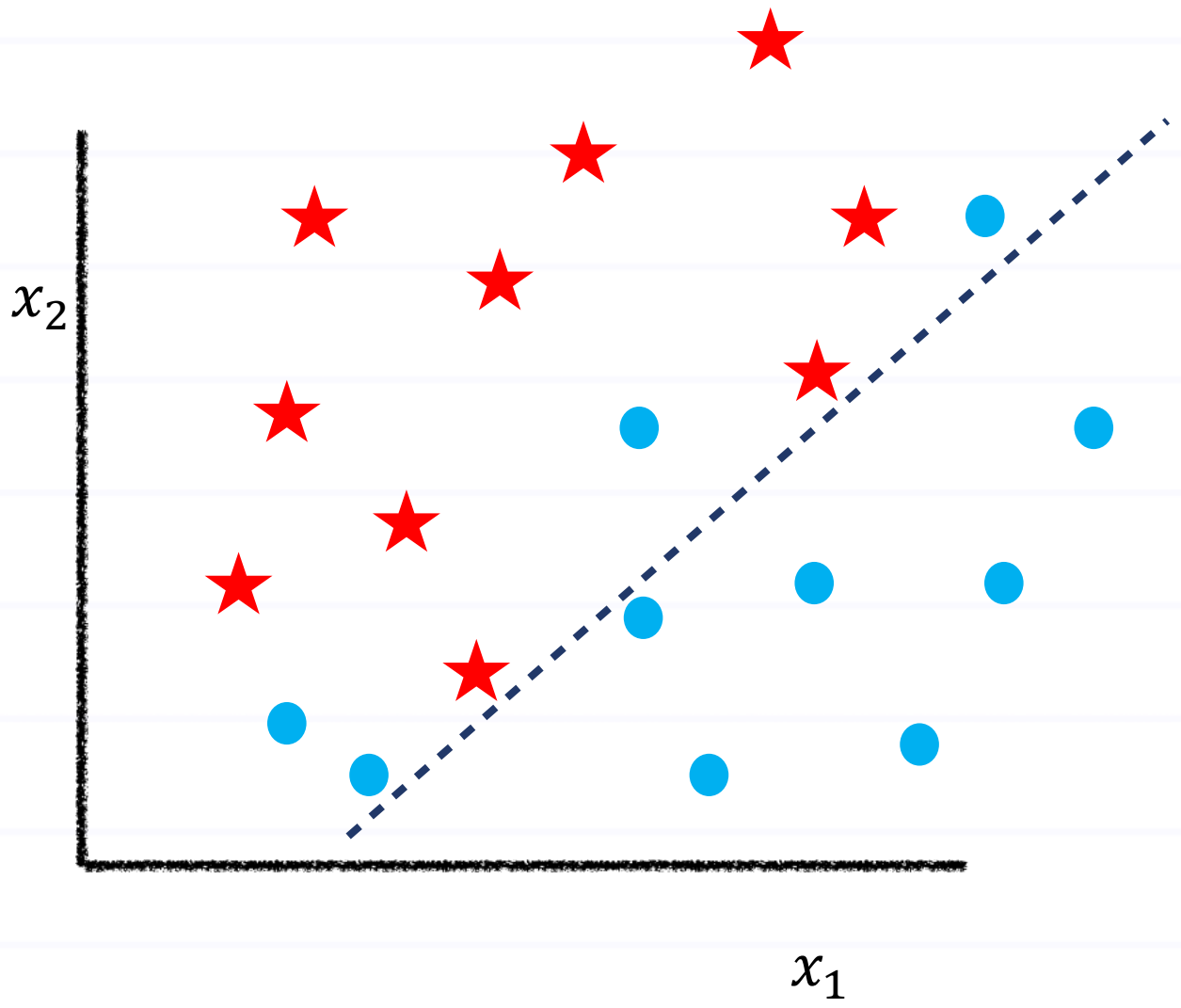

x_2
x_1

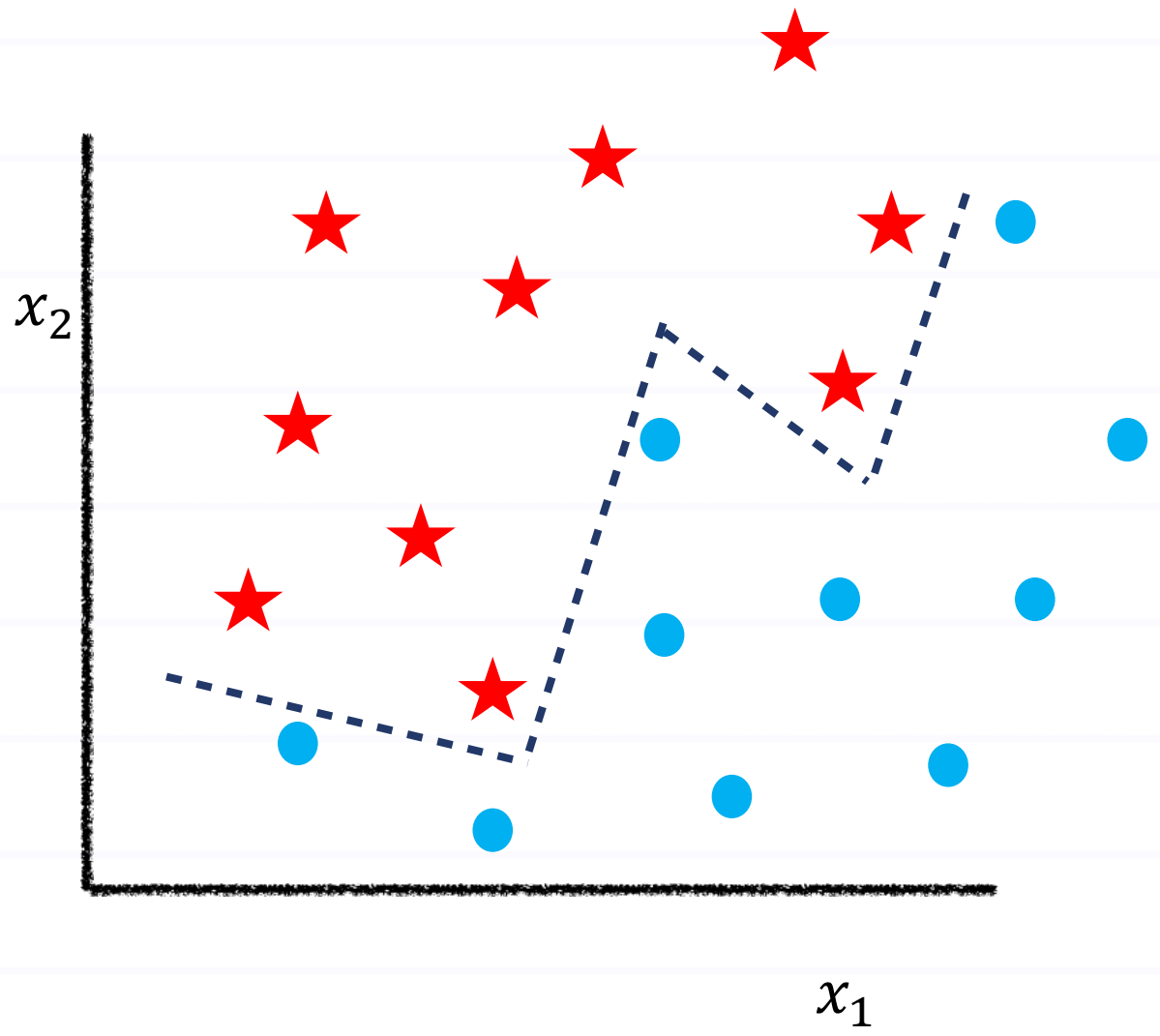
Not always!!!

Fraud detection

★ = Fraudulent transaction

● = Genuine transaction




x_2
x_1

Machine Learning

- Training set
  - Inputs, $\{\boldsymbol{x}_1, \boldsymbol{x}_2, \ldots\}$
  - Targets, $\{\boldsymbol{y}_1, \boldsymbol{y}_2, \ldots\}$
- Test set
  - Inputs, $\{\boldsymbol{x}_1^t, \boldsymbol{x}_2^t, \ldots\}$
  - Unseen targets, $\{\boldsymbol{y}_1^t, \boldsymbol{y}_2^t, \ldots\}$

References

- "Pattern Recognition and Machine Learning", C.M. Bishop, 2nd Edition, Springer, 2011. **Chapter 1**