

# Single Layer Perceptron (The Perceptron)

# Perceptron

- A single artificial neuron that computes its weighted input and uses a **threshold** activation function.
- It effectively separates the input space into **two categories** by the hyperplane:

$$\mathbf{w}^T \mathbf{x} + b = 0$$

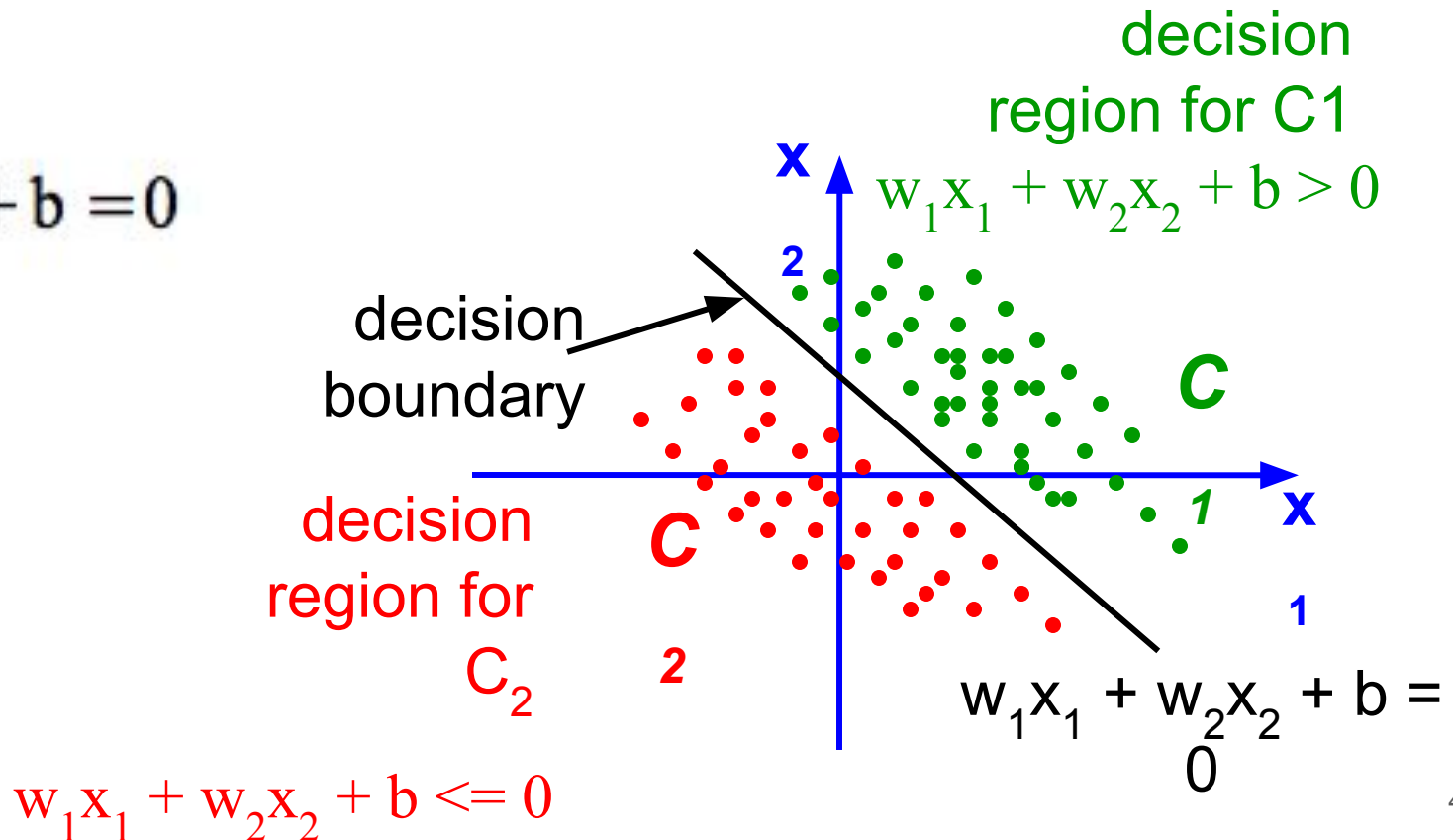
# Application

- The perceptron is used for classification: classify correctly a set of examples into one of the two classes  $C_1$ ,  $C_2$ :
- If the output of the perceptron is +1 then the input is assigned to class  $C_1$
- If the output is -1 then the input is assigned to  $C_2$

# Classification with Perceptron

The equation below describes a hyperplane in the input space. This hyperplane is used to separate the two classes C1 and C2

$$\sum_{i=1}^m w_i x_i + b = 0$$



# Limitations of Perceptron

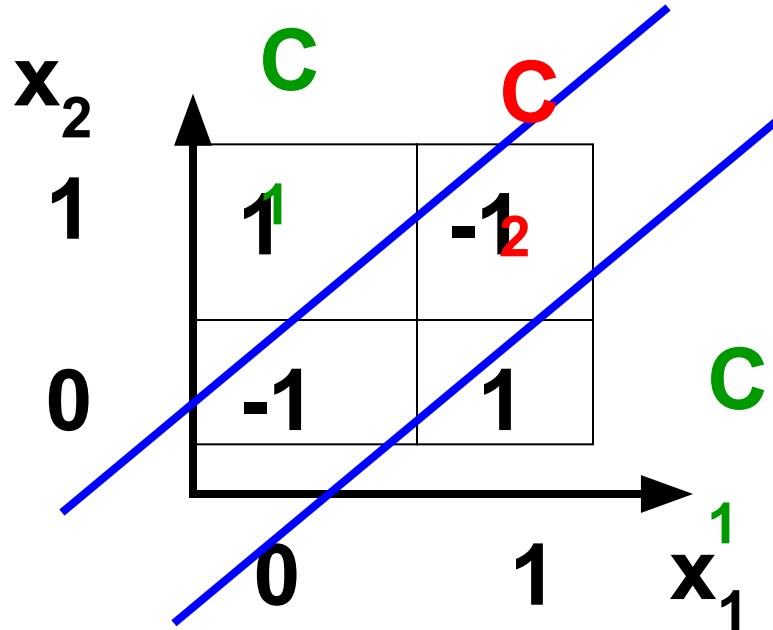
- The perceptron can only model linearly separable functions.
- The perceptron can be used to model the following Boolean functions:
- AND
- OR
- COMPLEMENT

But it cannot model the XOR. Why?

# The XOR problem

The **XOR** is not linear separable

It is impossible to separate the classes  $C_1$  and  $C_2$  with only one line



# Perceptron Implementation in Python

- The **Perceptron** class from **sklearn.linear\_model** provides an implementation of the perceptron algorithm for binary classification tasks in Python.
- It is imported as follows

```
from sklearn.linear_model import Perceptron
```

Refer to the notebook *4\_(b)\_practicals\_Perceptron.ipynb*